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**THIS ISSUE CONTAINS:**

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Transportation  
National Highway  
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Administration



*Shelve in Stacks  
S.B.T.*

# Highway Safety Literature

...A MONTHLY ABSTRACT JOURNAL

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Documents listed in **Highway Safety Literature** are not available from the National Highway Traffic Safety Administration unless so specified. They must be ordered from the sources indicated on the citations, usually at cost. Ordering information for the most common sources is given below.

**NTIS:** National Technical Information Service, Springfield, Va. 22151.  
**Order by title and accession number: PB, AD, or HS.**

**GPO:** Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. **Give corporate author, title, personal author, and report number.**

**Corporate author:** Inquiries should be addressed to the organization listed in the individual citation.

**Reference copy only:** Documents may be examined at the NHTSA Technical Reference Division or borrowed on inter-library loan through your local library.

**See serial citation:** Obtain through normal loan or purchase of the given serial.

**SAE:** Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001.  
**Order by title and SAE report number.**

**TRB:** Transportation Research Board, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

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HS-014 246

### **GENERAL MOTORS ON PRODUCT SIZE AND SAFETY**

The laws of physics and small car safety are discussed from the viewpoint of the small car buyer. Current data on small car safety relative to collision frequency, injury patterns, and accident avoidance capabilities are examined. It is recommended that small car occupants drive defensively, take advantage of small car maneuverability in collision situations, and wear belt restraints. Theoretical considerations favoring the large car are noted along with the general extent of highway problems and the effect of removal of large or small cars.

by J. W. Scheel; A. J. Yanik  
GENERAL MOTORS CORP., WARREN, MICH.  
Environmental Activities Staff  
Rept. No. a-3058 ; 1974 ; 8p 7refs  
Availability: Corporate author

HS-014 247

### **THE CHALLENGE OF DEVELOPING PERFORMANCE TESTS**

by F. C. Brenner  
National Hwy. Traf. Safety Administration, Washington, D. C.  
Publ: ASTM Standardization News v1 n9 p8-14,47 (Sep 1973)  
1973 ; 12refs  
Availability: See serial citation

HS-014 248

### **HUMAN WEIGHT DISTRIBUTION DURING IMPACT-LAP BELT, AIR BAG AND AIR FORCE HARNESS RESTRAINT SYSTEMS**

Thirty-two sled tests were conducted with 19 human volunteers using the lap belt, air bag, and Air Force harness restraint systems. The component parts of the restraint systems were instrumented and force-time recordings were made during impact. The impulse-momentum theorem was used to find the proportion of human weight which went into each component of the restraint system. The component weights were converted to percentages and a mean computer for each component of each system, and drawings were made to portray the weight distribution into the three systems. The weight distribution information will prove useful in the design and verification of dummies to be used in impact testing, and to designers of mathematical models of human impact.

by C. D. Gragg; T. D. Clarke; J. F. Sprouffske  
Aeromedical Res. Lab. (6571st), Holloman AFB, N. Mex.  
Rept. No. AD-769 541; AMRL-TR-73-103 ; 1971 ; 17p 7refs  
Reprinted from Proceedings of the 17th Annual Meeting of Inst. of Environmental Sciences, Los Angeles, Apr 1971.  
Availability: NTIS

HS-014 249

### **PATTERNS IN THE SEATING LOCATION AND INJURY LEVEL REPORTED FOR CHILDREN IN AUTOMOBILE ACCIDENTS**

Several police accident report files were examined to observe

younger children, up to about age four, are more commonly reported to have been in the front seat than in the rear; children who are about four years old or older are more likely to be in the rear seat; children are more likely possibly to be located in the front center when a male is driving and in the front rights when a female is driving; and REAR-SEATED CHILDREN ARE LESS LIKELY TO BE INJURED THAN FRONT-SEATED children. Given an injury, the children in the rear seat sustained more severe or fatal injuries than those in the front seat.

by R. Shortridge  
Publ: HIT LAB Reports v4 n3 p1-8 (Nov 1973)  
1973  
Availability: See serial citation

HS-014 250

### **HOLOGRAPHIC INSPECTION OF TIRES**

A method of nondestructively detecting internal anomalies or void areas in tires which is available commercially is described. The system uses holographic interferometry in conjunction with vacuum stressing and has been used by General Motors for structural analysis of tires prior to, during, and after testing. The equipment is described and the process and utility of passenger car tire analysis explained.

by M. J. Cannazzaro; F. W. Hill, Jr.  
General Motors Proving Ground, Milford, Mich.  
Rept. No. SAE-740071 ; 1974 ; 6p 3refs  
Presented at Automotive Engineering Congress, Detroit, 25 Feb-1 Mar 1974  
Availability: SAE

HS-014 251

### **EXTERNAL COMBUSTION ENGINES: PROSPECTS FOR VEHICULAR APPLICATION**

External combustion engines (such as the steam engine) are discussed as possible alternatives to the internal combustion engine for vehicle propulsion. Potential advantages are low levels of exhaust pollution, quiet operation, high starting torque, and possible lower costs over a vehicle lifetime. Present experience with the California Steam Bus Project indicates that competitive road performance is obtainable with steam-powered city buses, but fuel consumption is higher than with a diesel engine. Opportunities remain open for the evolutionary improvement of thermal efficiency. Logical early applications include stop-and-go fleet vehicles, with other possibilities to be determined.

by R. A. Renner  
International Res. and Technology Corp., Washington, D. C.  
1972 ; 25p 13refs  
Presented at Highway Research Board 51st Annual Meeting, Washington, 20 Jan 1972; based on results of the California Steam Bus Project.  
Availability: Corporate author

HS-014 252

### **A COMPARISON STUDY OF THE DRIVER VISUAL PART-TASK DURING LEFT- AND RIGHT-HAND**

## **FREEWAY MERGING MANEUVERS BY COMPUTER SIMULATION**

The degree of quantifiable difference in the mechanical elements of the driver visual part-tasks associated with merges from left hand on-ramps as compared to mirror image right hand entrance maneuvers is examined. A general computer model was developed to simulate dynamically the visual part-task. For both left and right hand merging there were six geometric configurations considered. The results from the simulation runs clearly showed that there is a significant difference in the ramp driver's ability to see the vehicle traveling on the freeway when he is merging from the left as compared to the right. They also showed that the closer a driver is to the ramp nose in the dilemma zone before he is allowed to see the freeway, the less will be the chance that he can see the critical freeway vehicle before he merges.

by P. H. DeCabooter; K. C. Sinha  
Wisconsin Dept. of Transportation, Madison; Marquette Univ., Milwaukee, Wis.  
1972 ; 33p 8refs  
Prepared for presentation at Highway Research Board 51st Annual Meeting, Washington, 21 Jan 1972.  
Availability: Corporate author

HS-014 253

## **ANALYSIS AND DESIGN PROCEDURES FOR THE PENNSYLVANIA HIGHWAY LIGHTING NEEDS STUDY**

A highway lighting needs study was conducted to determine the financial implications of bringing Pennsylvania's highway lighting into compliance with the federal requirements resulting from the Highway Safety Act of 1966. The study involved the collection and analysis of data taken at a sample of more than 1200 sites from the population of 4591 sites that require lighting under the federal standards. Procedures were developed to facilitate the rapid design of lighting where none existed, the evaluation of lighting at existing installations, and the redesign of existing inadequate installations. Installations, maintenance, and energizing costs were estimated. The techniques developed for the study are presented and discussed in terms of their value to the project. Applications of the design and analysis are discussed in terms of time savings and cost estimation.

by J. H. Herendeen, Jr.  
Pennsylvania State Univ., University Park. Pennsylvania Transp. and Traf. Safety Center  
Rept. No. TTSC-7114 ; 1972 ; 20p 5refs  
Prepared for presentation at the 51st Annual Meeting of the Highway Research Board, Washington, Jan 1972.  
Availability: Corporate author

HS-014 254

## **EVALUATING THE TRAFFIC CONFLICTS TECHNIQUE**

The Traffic Conflicts Technique, as developed by General Motors Research Labs., was evaluated in field tests and an attempt was made to find if there is a statistical relationship between traffic accidents and traffic conflicts. Conflicts were

tribute to accident causation can be more readily exposed by using conflicts than by using conventional accident analysis techniques. This may be especially true at low volume rural intersections. Because of this ability to provide more precise information, lower cost remedial actions should result. Correlation coefficients were calculated for bivariate populations of number of conflicts and number of corresponding accidents. The compiled data tend to support the finding that conflicts and accidents are associated.

by W. T. Baker  
Federal Hwy. Administration, Washington, D.C.  
1973? ; 25p 2refs  
Availability: Corporate author

HS-014 255

## **SKID RESISTANCE**

Skid resistance is examined in terms of its role in the prevention of accidents and hydroplaning, its measurement methods, the pavement surface characteristics (including macro- and microtexture) which affect it, deteriorating agents, design and construction factors that influence its degree, maintenance techniques, and measures to ease skid resistance requirements. Factors that interact with pavement skid resistance to produce undesirable results include driver habits, vehicle and highway design, and wet pavement. Various skid resistance testers are detailed. Methods of measuring pavement surface texture are shown, and surface properties and grooving are discussed. Surface texture changes due to general wear, traffic polishing, and the use of studded tires are examined. Paving materials and their characteristics are studied and finish-techniques given. Maintenance techniques discussed include surface modification and resurfacing, and their skid resistance control effects are explained. Required skid resistance surveys, their objectives, methods, and data management are covered. Traffic management, education, and removal of hazards are suggested as means of lowering skid resistance requirements. An appendix summarizes existing practices and solutions to slippery pavements.

Highway Res. Board, Washington, D. C.  
Rept. No. NCHRP-SHP-14 ; 1972 ; 66p 115refs  
Sponsored by the American Assoc. of State Hwy. Officials in cooperation with the Federal Hwy. Administration.

HS-014 256

## **HIGHWAY NOISE SOURCES**

Noise sources vary with speed and operating conditions. Four categories of noise (intake, exhaust, engine, and chain noise) are investigated for cars, trucks, motorcycles, and buses. Means of controlling the various noise sources are discussed. It is concluded that near-term control will require continued enforcement of vehicle noise controls with emphasis on exhaust, induction, and tire noise sources. Longer term improvements in vehicle noise levels can be achieved through redesign of vehicle components such as fans, radiators, engine enclosures, and tires coupled with highway design features such as noise barriers.

by W. H. Close  
 Department of Transp., Washington, D. C.  
 Publ: Highway Research Record n448 p5-11 (1973)  
 1973 ; 8refs  
 Publication sponsored by HRB Task Force on Highways and  
 the Environment.  
 Availability: See serial citation

by A. B. Mobley  
 Highway Res. Board, Washington, D. C.  
 1974 ; 34p  
 Availability: Corporate author

HS-014 310

### **SUMMARY OF NATIONAL TRANSPORTATION STATISTICS. FINAL REPORT**

A compendium of selected national-level transportation statistics is presented. Included are cost, inventory, and performance data describing the passenger and cargo operations of the following modes: air carrier, general aviation, automobile, bus, truck, local transit, rail, water, and oil pipeline. The report includes basic descriptors of U. S. transportation, such as operating revenues and expenses, number of vehicles and employees, vehicle-miles and passenger-miles. The report is a summary of a larger data base, consisting of time-series collected from a variety of government and private statistical handbooks. The data cover the period 1961 through 1971.

by G. V. Hicks; S. Y. Sheppard  
 Department of Transp., Cambridge, Mass. Transp. Systems  
 Center  
 Rept. No. DOT-TSC-OST-73-36; PB-226 747 ; 1973 ; 128p  
 21refs  
 Availability: NTIS

HS-014 311

### **CRASH TEST DEVICE DEVELOPMENT; REPEATABLE PETE. FINAL REPORT**

A new crash test device, Repeatable Pete, was developed to aid in the evaluation of the injury reducing potential of automotive passenger restraint systems. The general design criteria were: repeatability of test results; reproducibility of test results; human-like responses in a moderate automotive crash environment; and nonfrangibility. Biomechanical data describing the dynamic impact responses of unembalmed cadavers was used as a basis for humanlike performance. New and uniquely repeatable joints were developed. A urethane head and chest with more humanlike dynamic response was also developed. Self-skinning urethane foam was used extensively. Great care was used throughout to insure proper isolation of metal components. Extensive sled testing of two devices was done to verify performance.

by J. H. McElhaney  
 Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.  
 Rept. No. UM-HSRI-BI-73-3-1; PB-225 162 ; 1973 ; 162p refs  
 Sponsored by Motor Vehicle Manufacturers Association.  
 Availability: NTIS

HS-014 312

### **INVESTIGATIVE REPORT: FIRE AND FICTION**

The statistics of deaths and injuries caused by fire resulting from fuel spillage during and after motor vehicle accidents are cited and refuted. It is noted that reliable statistics and documentation are not actually available. The objection of some automobile manufacturers to compliance with DOT safety standards for fuel spillage is presented. More current studies of fire injuries are shown to result in lower statistics. It is concluded that the government acted prematurely on inadequate

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### **HYDROPLANING**

The effects of hydroplaning are discussed with emphasis on the conditions which make it possible. Speed and tire pressure interaction is determined, along with water depth, road surface, and tire characteristics. Viscous hydroplaning is differentiated from dynamic hydroplaning, and it is noted that this type can occur without rain, with only dew from damp night air. Methods are suggested to avoid hydroplaning, such as slowing down, cornering carefully, being alert for loose steering, knowing the condition/design of the tires, and testing brake action.

Publ: Driver v7 n9 p1-6 (Feb 1974)  
 1974  
 Availability: See serial citation

HS-014 258

### **REGULATION VESC-10: MINIMUM REQUIREMENTS FOR TYPE II SCHOOL BUS CONSTRUCTION AND EQUIPMENT**

Minimum standards for the construction and equipping of Type II School Buses manufactured after January 1, 1975 are presented. The bus is any motor vehicle with provision for 13 inches of seating space width for a maximum of 16 passengers exclusive of the driver, designed principally for the transportation of pupils in 12 or lower grades to and from school. Standards are detailed for construction of body, chassis requirements, electrical system requirements, and equipment requirements such as fire extinguishers, first aid kit, warning devices for disabled vehicles, and locked compartment.

Vehicle Equipment Safety Commission, Washington, D. C.  
 1973 ; 26p  
 Availability: Corporate author

HS-014 259

### **A PRELIMINARY REPORT ON THE HIGHWAY RESEARCH INFORMATION SERVICE ON-LINE RETRIEVAL DEMONSTRATION PROJECT**

The status of the Highway Research Information Service (HRIS) is presented with focus on the on-line retrieval demonstration project. Sponsors and participants are described along with the Transportation Research Information Services Network (TRISNET) and its file composition. Such project phases as acquisition and reports, objectives, and participant data are detailed. It is noted that due to timing problems, a limited amount of data has been acquired. The project's continuance through July 31, 1974 is recommended.

information, and failed in its duty to protect the public with appropriate measures.

by F. M. H. Gregory

Publ: Motor Trend, v25 n3 p84-6 (Mar 1974)

1974

Availability: See serial citation

HS-014 313

## COMPARISON OF YIELDING AND ELASTIC RESTRAINT SYSTEMS FOR CRASH PROTECTION

The performance of crash protective seat belts can be improved by the incorporation of energy absorbers which allow the restraint to yield at constant load. Mathematical models are produced to show the effects of slack and yield on restraints designed for maximum body loadings of 12 and 20 g. Under these conditions it is shown that yielding systems reduce sensitivity to slack and, for given restraint load and 8 to 12 inches of yield, could double the allowable input acceleration.

by S. R. Sarraillhe

Aeronautical Res. Labs., Melbourne, Vic. (Australia)

Rept. No. ARL/SM.382 ; 1972 ; 24p refs

Availability: Corporate author

HS-014 314

## VISUAL ASPECTS OF ROAD ENGINEERING

Visual aspects of road engineering are discussed in an attempt to provide for adequate visual information conveyance to the driver. The capabilities of the human visual system for attributes of detection, temporal resolution, spatial resolution, and color discrimination are reviewed. About 20% of all drivers will have a visual capacity for one or more of these attributes which falls short of the maximum attainable. It is argued that the visual requirements imposed by licensing authorities do not and should not exclude these drivers from holding a license to drive; rather, road design should account for defective vision. The common defects of vision are reviewed and their effect on design considered.

by B. L. Cole

Melbourne Univ., Vic. (Australia)

Publ: Australian Road Research Board Proceedings v6 pt1

p101-48 (1972)

Rept. No. Paper 820 ; 1972 ; 147refs

Presented at the Sixth Conference of the ARRB.

Availability: See serial citation

HS-014 315

## A SWEPT PATH MODEL WHICH INCLUDES TIRE MECHANICS

A mathematical model for vehicle offtracking is described which includes the effects of tire mechanics. The model has been used to predict results from full-scale tests on five semitrailers. One of the tests was carefully controlled and the results agree with the model simulations to within about 1%. Agreement with model results for the other four vehicles was not as good, and it is concluded that this is because these tests were not as well controlled. The effects of a wide range of tire operating conditions have been explored with the model, and it

is concluded that models which neglect tire mechanics can be in error by as much as 35%, for some vehicles and under certain conditions.

by W. R. B. Morrison

Oceanics Australia Pty. Ltd., Brisbane, Qld.

Publ: Australian Road Research Board Proceedings, v6 pt1 p149-82 (1972)

Rept. No. Paper-891 ; 1972 ; 16refs

Presented at the Sixth Conference of the ARRB.

Availability: See serial citation

HS-014 316

## THE IMPACT OF THE MOTOR VEHICLE ON URBAN COMMUNITIES

The degree to which the largely unplanned for upsurge motor vehicle use in urban areas has led to problems of accessibility, movement, and environmental change is discussed. The effectiveness of solutions, especially urban freeways, explored together with observations on the side effects these solutions in a planning and political sense. A project is made on alternatives to be pursued, such as rigid control of future growth of established central business districts in favor of stimulated development of sub-nodes; the competing interests of the private and public transport section; and the creation of urban freeways in public reservations or as part of an urban redevelopment program.

by L. M. Perrott

Perrott, Lyon, Timlock and Kesa, Architects, Melbourne, V (Australia)

Publ: Australian Road Research Board Proceedings, v6 pt1 p183-96 (1972)

Rept. No. Paper-903 ; 1972

Presented at the Sixth Conference of the ARRB.

Availability: See serial citation

HS-014 317

## AGING AND HIGHWAY SAFETY: THE ELDERLY IN A MOBILE SOCIETY

The rights of the older driver and pedestrian and the limitations society imposes on them in exercising their rights are discussed in symposium presentations. Topics covered include: the aging driver in today's traffic; a critical review of problems of the aging driver; elderly pedestrians and drivers; and a bibliography (1962-1972) of the literature of aging pedestrians and drivers.

by P. F. Waller, ed.

North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center 1973 ; 113p refs

Presented at North Carolina Symposium on Highway Safety 1972. Includes HS-014 318--HS-014 319.

Availability: Corporate author

HS-014 318

## THE AGING DRIVER IN TODAY'S TRAFFIC: A CRITICAL REVIEW

The aging driver is described and it is suggested that chronological age is an arbitrary and sometimes erroneous indicator of capacity, and that drivers should be assessed individually and not as a group. A review of the literature

icates that aging drivers have a higher accident rate, but because they drive less, their contribution to the overall accident rate is not as significant as younger age groups. The elderly have less serious accidents and reduced difficult driving, but they are more likely to suffer serious injury or death. The relationship between sensory deficiencies and driving ability is discussed, and suggestions are made for further research. The role of and procedures for physical examinations for license renewal are also considered.

by T. W. Planek  
National Safety Council, Chicago, Ill.  
Publ: North Carolina Symposium on Highway Safety v7 pl-38  
(Fall 1972)  
1973 ; 45refs  
Availability: IN HS-014 317

HS-014 319

### PROBLEMS OF THE AGING DRIVER

Problems of elderly drivers are discussed and a comprehensive educational approach is recommended, including safe driving practices, and supportive counseling on such topics as diet and exercise, the effects of medications on driving ability, handling anger and anxieties, and keeping useful. Effects of driver emotional health are emphasized. Benefits of the multi-faceted approach to driver education of the elderly are assessed.

by W. A. Mann  
Michigan State Univ., East Lansing  
Publ: Published in North Carolina Symposium on Highway Safety v7 p39-50 (Fall 1972)  
1973 ; 9refs  
Availability: IN HS-014 317

HS-014 320

### EQUIPMENT PROTECTION THROUGH CUSTOMIZED OIL ANALYSIS

The development of an automated and computerized used oil analysis system designed to monitor equipment and lubricant condition is described. The techniques covered are differential infrared analysis, membrane filtration, viscosity determination, and analysis of wear metals. The customized used oil analysis is outlined, and field application and case studies described. The system provides an early warning to forestall potential problems and imminent equipment damage, monitors wear and dirt levels, identifies possible deposits and their nature, pinpoints engine conditions causing oil degradation, and recommends corrective action. It also reduces laboratory analysis and reporting time for more rapid response to equipment operators. It has proved to be a valuable tool for predictive maintenance.

by J. P. O'Hara; A. B. Sarkis; W. A. Kennedy  
Mobil Oil Corp., New York  
Rept. No. SAE-730745 ; 1973 ; 26p 4refs  
Presented at National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 321

### AN ENGINEERING APPROACH TO DIESEL TRUCK NOISE REDUCTION

The White Motor Corp. approach to heavy-duty diesel truck noise reduction is described. As a part of the U. S. Department of Transportation Quiet Truck Program, a unique free field stationary vehicle noise test facility was designed and built for noise control development. The features of this facility and the techniques employed in vehicle noise source identification are presented.

by J. W. Thompson  
White Motor Corp., Cleveland, Ohio  
Rept. No. SAE-730713 ; 1973 ; 13p 1ref  
Presented at SAE West Coast Meeting, Portland, Ore., 20-23 Aug 1973.  
Availability: SAE

HS-014 322

### CALIFORNIA DRIVER TRAINING EVALUATION STUDY. FINAL REPORT

The benefits and costs of state high school driver training courses were compared with those of commercial driving school training, and short with long training programs. Twelve thousand high school students were randomly selected and assigned to programs. Summarized conclusions include: commercially trained students and long program students were superior; short simulator students were inferior to other groups; males were superior except in attitude; commercially trained and long program students make higher road test scores; no differences show between standard simulator and standard 6 hr. in-car programs; females require longer to be licensed; licensing rate for trainees is low; traffic citation and accident rates are similar for publicly and commercially trained students; citation and accident rates between long and short programs and between simulator and six-hour programs showed no significant differences; males have worse citation and accident records; few students practice; teaching techniques vary significantly; in-car student observation time is little used; and commercial training and 6 hr. programs seem to be the methods of choice.

by M. H. Jones  
California Univ., Los Angeles  
1973 ; 425p 32refs  
Prepared in cooperation with California Dept. of Motor  
Vehicles. Final report to the Legislature of the State of  
California in accord with Chapter 1454--1969 General Statutes.  
Availability: Corporate author

HS-014 323

### A COMPARISON OF BREATHALYZED DRIVERS WITH THE GENERAL DRIVING POPULATION

Characteristics of a sample of drivers breathalyzed in the Melbourne, Australia metropolitan area are compared with those of the general driving population. Only male drivers resident in the metropolitan area were included, and the possession of a current driver's license was a prerequisite. A total of 382 male breathalyzed drivers and 352 drivers from the general population were studied. It is shown that if the offense which brought them into the survey is excluded, breathalyzed drivers have 10 times as many convictions for drunk driving and other serious traffic offenses as the drivers in the population at large; charges for serious traffic offenses were frequently associated with drunk driving charges; blood alcohol concentrations of drivers with multiple drunk driving convictions varied; age was not a factor.

by A. Raymond  
Publ: Journal of the Australian Road Research Board v4 n8  
p52-61 (Mar 1972)  
1972 ; 3refs  
Availability: See serial citation

HS-014 324

### DRIVING CONVICTIONS OF A RANDOM SAMPLE OF VICTORIAN DRIVERS

A control sample of 970 Victorian (Australia) car license holders is presented as a preliminary to examining the driving behavior of certain groups of drinking drivers. Of the sample, 818 held licenses current on 1 Aug 1969. Of these, 32% of the males and 5% of the females had convictions for driving offenses. Convictions for drunk driving offenses and for other serious driving offenses were incurred by only a small minority of drivers almost all of whom were male. A large proportion of the drinking drivers had repeated convictions, and there was an overlap between drunk driving offenders and those convicted of other serious offenses. There were 17 drunk driving offenders, all males, four of whom had more than one drunk driving conviction. Twenty-one males and three females were convicted of other serious traffic offenses. Four of these males had also incurred drunk driving convictions on some separate occasion.

by A. Kornaczewski; P. Wilkinson; A. Raymond; J. G. Rankin; J. N. Santamaria  
Publ: Journal of the Australian Road Research Board v4 n8  
p40-51 (Mar 1972)  
1972 ; 2refs  
Availability: See serial citation

HS-014 325

### MEASUREMENTS ON THE NIGHT-TIME VISIBILITY OF SIGNS AND DELINEATORS ON A AUSTRALIAN RURAL ROAD

The visibilities of in-service signs and delineators were measured under practical driving conditions on a four-lane divided highway, with the night-time experiments conducted with American-British dipped beams. It was found that the night-time legibility distances of reflective signs were on average half those obtained during the day-time. Aging and dirt accumulation were shown to reduce sign legibility distances 30% or more at night, and to reduce the reflectivity of delineators on guide posts 10 ft. from the pavement by 18 times. The mean detection distance for the 3-ft. guide posts were 59 ft. for normal observers. The guide posts were slightly more legible than their red delineators. For a color defective observer the mean detection distance of the delineators was half of the guide post. The dependence of current signing and delineation practices in Australia upon a high level of maintenance is shown.

by B. L. Hills  
Publ: Journal of the Australian Road Research Board v4 n8  
p38-57 (Dec 1972)  
1972 ; 21refs  
Availability: See serial citation

HS-014 326

### STORAGE/OUTPUT DESIGN OF TRAFFIC SIGNALS

A traffic signal storage output-capacity factor K represents the proportion of design inflow for which output capacity should be designed is suggested. The amount of storage required for various K values is examined for Brisbane, Australia, and some suggestions are made on selection of an equilibrium K value. Since this is postulated as an equilibrium congestion value, design for higher K values (low volume/capacity ratios) will tend to cause system effects which will ensure all out come different from that planned.

by W. M. Rahmann  
Publ: Journal of the Australian Road Research Board v5 n1  
p38-43 (Apr 1973)  
1973 ; 5refs  
Availability: See serial citation

HS-014 327

### FATIGUE AND DRIVING--A THEORETICAL ANALYSIS

A general theory of fatigue developed during an extensive study of aircrew fatigue is described, and its application to driving fatigue is attempted. From the theory, four specific predictions are made: effects of extended performance are likely to be less significant than effects of lack of sleep; severe fatigue effects are likely to be confined mainly to



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professional driving population, more particularly the long haul transport operator; measureable decrement in quality of driving performance is likely to be small, even after extended periods of driving; a complex interaction between lack of sleep, motivational factors and task variables is to be expected, such that an increase in task demand will be matched by increased effort, and will not produce any significant decrement in driving performance. The critical condition is likely to be extended period of uneventful driving when the driver has accumulated a sleep deficit.

by C. Cameron  
Publ: Journal of the Australian Road Research Board v5 n2  
p36-44 (Jun 1973)  
1973 ; 26refs  
Availability: See serial citation

HS-014 328

### **AGE AND DRIVING EXPERIENCE IN RELATION TO ROAD TRAFFIC ACCIDENTS**

An examination of casualty accident records was undertaken to determine the effects of driving experience on the accident pattern of drivers with various levels of experience. The period elapsed between first licensing and the time of accident was used as the measure of driving experience. Regardless of age of driver, less experienced drivers were found to have a higher relative likelihood than more experienced drivers of having an out-of-control type of accident. This tendency was most marked among drivers involved in accidents in rural areas. The results suggested that the particularly high over-involvement of young male drivers in out-of-control accidents may be attributable, to an important extent, to their lack of driving experience.

by R. Bence  
Publ: Journal of the Australian Road Research Board v5 n2  
p45-55 (Jun 1973)  
1973 ; 6refs  
Availability: See serial citation

HS-014 329

### **A REVIEW ON ROAD-TYRE FRICTION**

A historical survey of road-tire friction under wet and dry road conditions is presented, with emphasis on the wet road friction. The factors affecting the road-tire friction are listed and their influence discussed. It is stressed that both the qualitative assessment of texture and the quantitative assessment by sand patch method presently adopted by many researchers do not take into consideration all the relevant characteristics of the road surface texture. It is suggested that if the road surface texture can be satisfactorily measured and defined quantitatively, then the texture dependence of road-tire friction can be more precisely studied and the interaction effects of other factors influencing the road-tire friction can be better understood.

by L. Holla; W. O. Yandell  
Publ: Journal of the Australian Road Research Board v5 n2  
p76-91 (Jun 1973)  
1973 ; 77refs  
Availability: See serial citation

HS-014 330

### **AUTOMOTIVE AIR POLLUTION IN URBAN ROAD SYSTEMS: A CONTRIBUTION TO THE ANALYSIS**

Various relationships that determine the emissions of pollutants from vehicles are outlined, along with the consequential dispersal of these emissions in the atmosphere, and the levels of concentration of pollutants in urban areas. These relationships are formulated in a model appropriate for systems analysis, and the availability of data to quantify and operate the model is assessed. To illustrate the proposed approach, a simple model developed for the estimation of changes in automotive air pollution levels in an urban area is briefly described. The applications of the model are demonstrated and some priorities for further research proposed.

by N. W. F. Fisher; P. M. J. Fisher  
Australia Commonwealth Bureau of Roads, Melbourne, Vic.; Paterson (John) Urban Systems Pty. Ltd., North Melbourne, Vic. (Australia)  
Publ: Australian Road Research Board Proceedings v6 pt2  
p404-36 (1972)  
Rept. No. Paper-841 ; 1972 ; 21refs  
Presented at the Australian Road Res. Board 6th Conference. Includes discussion by R. T. Underwood, W. J. Taylor, J. H. Vance, R. A. Dunstan, and H. D. Taskis, and author's closure.  
Availability: See serial citation

HS-014 331

### **ROAD-RAIL PROTECTION--AUDIBLE WARNING EFFECTIVENESS**

Suggestions are made on changes in methods of road vehicle operation which would take into consideration high winds and other factors and improve safety on railroad crossing approaches. Suggestions are also made on improvements to roadside audible warnings and standardization of audible signals that would be practical without degradation of the total environment. It is concluded that audible warnings still play a vital part in road-rail protection. In many instances revised motor vehicle operation could lead directly to a substantial reduction in the serious type of collision with high noise level road transports during periods of high winds, and an overall improvement in protection levels.

by J. J. Cox  
Victoria Dept. of Railways, Melbourne (Australia)  
Publ: Australian Road Research Board Proceedings v6 pt2  
p448-66 (1972)  
Rept. No. Paper-826 ; 1972 ; 21refs  
Presented at the Australian Road Res. Board 6th Conference. Includes discussion by R. A. Chapman and author's closure.  
Availability: See serial citation

HS-014 332

### **A REVIEW OF FREEWAY LIGHTING PRACTICE**

of lighting adopted by various authorities are discussed, and the levels of lighting and of uniformity that are adopted when freeways are lighted are examined along with some details of design. The relevance of overseas practice to Australian conditions is considered and suggested guidelines for lighting Australian freeways are offered. Some brief notes on freeway lighting experience in Victoria are included.

by R. T. Underwood  
Victoria Country Roads Board, Kew (Australia)  
Publ: Australian Road Research Board Proceedings v6 pt2  
p467-90 (1972)  
Rept. No. Paper-925 ; 1972 ; 29refs  
Presented at the Australian Road Res. Board 6th Conference.  
Includes discussion by R. G. Noakes, R. J. Dunn, G. H. Dash,  
and W. R. Blumden, and author's closure.  
Availability: See serial citation

HS-014 333

### **OVERTAKING SIGHT-DISTANCES ON A TWO-LANE RURAL ROAD**

The sight-distance drivers require to overtake a slow vehicle on a two-lane rural road was examined. The study investigated sight-distances terminated by a curve or crest in the road, rather than by opposing traffic. A car was driven along at a slow speed and the observations were made from within the car. The studies were made with the slow car travelling at 25 and 30 mph at a site on one of Victoria's rural highways. A log normal distribution of critical sight-distances was fitted to the data using maximum likelihood methods to estimate parameters. It was found that a small percentage of drivers would accept extremely small sight-distances for overtaking.

by R. J. Troutbeck; N. Szwed; A. J. Miller  
Publ: Australian Road Research Board Proceedings v6 pt2  
p286-301 (1972)  
Rept. No. Paper-939 ; 1972 ; 12refs  
Presented at the Australian Road Res. Board 6th Conference.  
Includes discussion by R. A. Chapman, R. A. Dunstan, C. L. Fouvy, S. G. C. Servais, and K. N. Stevenson, and author's closure.  
Availability: See serial citation

HS-014 334

### **INTERSECTION DIRECTION SIGNS--THE EFFECTS OF DESIGN UPON VISUAL performance**

A series of experiments are reported in which several designs for intersection direction signs having a white legend and border on a black background were examined to determine the relative ease with which drivers could identify the direction to which they point. The designs consisted of signs with either square or pointed ends, containing arrows, chevrons, or other pointer symbols. It was found that for identification of the direction indicated (left or right), signs with pointed ends gave markedly greater recognition distance values than those with square ends, regardless of the pointer symbols used, indicating that the pointed outline of the sign border is a valuable direction indicator in itself. The 70-degree chevron was the best pointer symbol for distinguishing the direction indicated and for identifying the shape of the pointer symbol.

by B. L. Hills; K. D. Freeman; J. P. Goldsmith  
Australian Road Res. Board, Kew, Vic.; Victoria Country Roads Board, Kew (Australia)  
Publ: Australian Road Research Board Proceedings v6 pt3  
p302-15 (1972)  
Rept. No. Paper-944 ; 1972 ; 14p 4refs  
Presented at the Australian Road Res. Board 6th Conference.  
Includes discussion by R. A. Chapman and author's closure.  
Availability: See serial citation

HS-014 339

### **THE MELBOURNE UNIVERSITY VARIABLE CHARACTERISTIC CAR**

A vehicle with variable handling characteristics has been designed, built and developed in the Dept. of Mechanical Engineering at the University of Melbourne with financial support from the Australian Road Research Board. The vehicle has been designed as a research tool for investigating driver performance as dependent on the characteristics of the vehicle and is applicable to all types of roads and driving tasks. Information acquired using this vehicle, showing how drivers steer, can lead to improved design of vehicles as well as the provision of more suitable cues in the road environment. The vehicle has variable response time, understeer-oversteer and steering ratio, all of which are likely to be of importance in the operation of the driver-vehicle system and these can be varied over such a range as to simulate most present day vehicles. The concept of a variable characteristic vehicle is introduced and the design and capabilities of the Melbourne vehicle are discussed with reference to the type of research in which it is to be used.

by P. Sweatman; P. N. Joubert  
Melbourne Univ., Vic (Australia)  
Publ: Australia Road Research Board Proceedings v6 pt3 p441-56 (1972)  
Rept. No. Paper-943 ; 1972 ; 21refs  
Presented at the Sixth Conference of the ARRB.  
Availability: See serial citation

HS-014 340

### **EVALUATION OF FACTORS INFLUENCING DRIVEWAY ACCIDENTS. INTERIM REPORT**

The relationship between the driveway accident rate and the average spacing between adjacent driveways and between a driveway and an adjacent intersection leg was examined, along with the characteristics of the roadway and its abutting environment having the most significant effect upon the driveway accident rate. The overall objective was to disclose the factors which, when properly employed, will serve to effect a significant reduction in the driveway accident rate. Data from 100 segments of 10 Indiana city arterial streets showed that driveway accidents represented 13.95% of the total traffic accidents on all the sections over a period of 4 years. It was found that the number of driveway accidents per mile per year decreased when the number of commercial driveways per mile was reduced; when the number of through traffic lanes on the arterial highway was reduced; when the number of total intersections per mile was increased; when the traffic volume on the arterial highway was reduced; and when the urban area population increased.

July 31, 1974

by W. W. McGuirk  
Joint Highway Research Project, Lafayette, Ind.  
Rept. No. JHRP-10 ; 1973 ; 152p 73refs  
Master's thesis, Purdue Univ.  
Availability: Corporate author

HS-014 335

## **EYE MOVEMENT ANALYSIS OF VISUAL INFORMATION ACQUISITION IN DRIVING: AN OVERVIEW**

Basic techniques of eye movement analysis are described and two systems developed at Ohio State University are discussed. Emphasis is placed on the corneal reflection 3-Vidicon system used in automobile driving. Applications include the use of eye movement technique to study perceptual search and scan pattern development in novice drivers, in predicting degradation patterns due to fatigue, and the use of eye-movement techniques in studying drivers at moderate levels of blood alcohol. The role of peripheral vision in driving and the concept of spare visual capacity are also described. The role of eye movements in information acquisition is proposed as one of the key elements in both the learning of driving performance and its degradation due to various stresses, and its special role in system evaluation for examples of highway signing.

by T. H. Rockwell  
Ohio State Univ., Columbus  
Publ: Australian Road Research Board Proceedings v6 pt3  
p316-31 (1972)  
Rept. No. Paper-948 ; 1972 ; 38refs  
Presented at the Australian Road Res. Board 6th Conference.  
Includes discussion by J. R. McLean and J. J. Cox.  
Availability: See serial citation

HS-014 336

## **DELAY AND ACCIDENT CHANGES FROM QUEUE SPLITTING**

The results of two previous papers on delay and accident changes from queue splitting are combined. The earlier report suggests that the number of accidents at a T-junction would increase if that junction were made into two T-junctions. The later paper demonstrates the savings in delay to side road traffic wishing to enter the main road which would be obtained by splitting a simplified junction into two. In the comparison of these results, it is found likely that the expected accident costs would be higher than the value of the delay saved.

by R. A. Chapman  
New Zealand Ministry of Transport, Wellington  
Publ: Australian Road Research Board Proceedings v6 pt3  
p337-44 (1972)  
Rept. No. Paper-815 ; 1972 ; 8refs  
Presented at the Australian Road Res. Board 6th Conference.  
Includes discussion by A. T. Fry and author's closure.  
Availability: See serial citation

HS-014 337

## **SOME PROBLEMS ARISING IN BEFORE-AND-AFTER ACCIDENT STUDIES WITH LIMITED DATA**

The usual methods for the analysis of the accidents occurring before and after road changes are inadequate in the common situation where it has not been possible to design an adequate experiment or when a pronouncement must be made too soon after the change. The Fisher-Yates test is preferred for 2 x 2 tables, but with this test as with the more common chi-square test, the power function, which is essential to rational decision making, is not known. A mathematical model for the occurrence of accidents at a point is set up but not tested.

by J. H. R. Youngman  
New Zealand Ministry of Transport, Wellington  
Publ: Australian Road Research Board Proceedings v6 pt3  
p384-92 (1972)  
Rept. No. Paper-938 ; 1972 ; 14refs  
Presented at the Australian Road Res. Board 6th Conference.  
Includes author's closure.  
Availability: See serial citation

HS-014 338

## **THE EFFECTS OF LANE WIDTH ON DRIVER STEERING CONTROL AND PERFORMANCE**

Driver steering control and performance were studied for straight lane driving in lanes of 8, 10, and 12-ft widths at speeds of 30, 40, and 50 mph. The results are compared with theoretical models of driver control developed by Rashevsky, and with free speed measurements taken for similar driving conditions. It appears that in most cases drivers were dominantly controlling the heading or path angle of the vehicle without close attention to lateral error. For extreme conditions of narrow lane width and high speed, drivers appeared to change their steering strategy to one dominantly involving direct control of lateral error, and there was a marked increase in the proportion of high frequency control movements and in both heading rate and heading angle error. It is suggested that the need to modify steering strategy could provide the upper bound for free speeds in narrow lanes when other restrictions are not present.

by J. R. McLean; E. R. Hoffmann  
Australian Road Res. Board, Kew, Vic; Melbourne Univ., Vic. (Australia)  
Publ: Australian Road Research Board Proceedings v6 pt3  
p418-40 (1972)  
Rept. No. Paper-881 ; 1972 ; 17refs  
Presented at the Australian Road Research Board 6th Conference, 1972. Includes discussion by J. F. M. Bryant, K.

HS-014 341

### **ROAD ROUGHNESS EFFECTS ON VEHICLE PERFORMANCE. FINAL REPORT**

A correlation was examined between the measured roughness of a road surface and the penalties imposed on the driver-vehicle system as a consequence of using the rough road. Three aspects of performance penalty were studied: vehicle wear, driver discomfort, and traction loss. Indices of performance penalty were determined for each aspect, the first two obtained by instrumenting the PennDOT Rapid Travel Profilometer vehicle to measure the required parameters, and the third derived from data taken from an experimental apparatus which employed an axle with vertical restraint. Major areas where further work is needed to refine the indices are outlined: the Wear Index and the Discomfort Index could be broadened to include other vehicles, and the traction loss data could be expanded to include the effects of vehicle suspension and body components.

by A. D. Brickman; W. H. Park; J. C. Wambold; J. R. Zimmerman  
Pennsylvania State Univ., University Park. Pennsylvania  
Transp. and Traf. Safety Center  
Rept. No. TTSC-7207 ; 1972 ; 220p 45refs  
Sponsored by the Pennsylvania Dept. of Transp., Bureau of  
Materials, Testing and Research. Penn.DOT Research Project  
69-15.  
Availability: Corporate author

HS-014 342

### **INVESTIGATION OF AUTOMOBILE HEADLIGHTING (NARRATIVE SUMMARY)**

The narrative of an audio-visual report on automobile headlighting research is reproduced with photographic excerpts. A procedure for comparing the performance of headlamps is outlined. Experimental data gathering is described and the form of eight computerized performance parameters is illustrated. The selection of merit criteria and rating values is open to the regulatory decision process.

by A. H. Hall; H. F. L. Pinkney  
National Aeronautical Establishment, Ottawa, Ont. (Canada)  
Rept. No. LTR-ST.612 ; 1973 ; 75p 15refs  
Includes French summary.  
Availability: Corporate author

HS-014 343

### **HISTORY OF THE AIR BAG AND MODIFIED STANDARD 208: THE LONG (AND UNFINISHED) ROAD TO UNIVERSAL PASSIVE PROTECTION OF AMERICA'S MOTORISTS**

The history of the air bag is traced from its design concept in 1952 through its current status and federal regulations. Department of Transportation's passive restraint system rulemaking procedures and progress are reviewed, and crashes of air bag-equipped cars are described. Warnings from General Motors about the need for industry leadtime for full-scale production

DOT delay in implementing Standard 208 and the benefits of the air bag over the seat belt system of occupant protection.

by I. Tether  
Center For Auto Safety, Washington, D. C.  
1974 ; 35p 28refs  
Availability: Corporate author

HS-014 344

### **EFFECTS OF ALCOHOL ON DRIVING PERFORMANCE: SEX DIFFERENCES**

Simulated driving performance of experienced male and female drivers at three blood alcohol concentration (BAC) conditions (.00%, .05%, and .10%) was compared. No statistically significant differences between BAC condition for either sex group was found, and neither did the male and female groups differ in performance. Gross individual differences in the performance of subjects within each group across BAC levels, were characteristic of all of the performance measures recorded. It is suggested that while sex does not appear to be the moderator variable responsible for individual differences in response to alcohol intoxication effects in the driving task, future research must be addressed to an explanation and evaluation of individual differences by systematic investigation of other moderator variables.

by V. S. Ellingstad; D. L. Struckman  
South Dakota Univ., Vermillion  
1972? ; 49p 17refs  
Sponsored by a grant from the Scientific Advisory Council to  
Licensed Beverage Industries, Inc.  
Availability: Corporate author

HS-014 345

### **EXPERIMENTAL INSTALLATIONS OF IMPACT-ATTENUATING DEVICES. FINAL REPORT**

From a survey of the interstate system in Kentucky, 26 gore sites were found to be eligible for safety improvements. Energy absorbing barriers were installed at five; barriers are planned at 11 sites; seven sites have been contour graded; and three have been dismissed from consideration. HI-DRO Cushions and Fitch Inertial Barriers were found to be effective crash cushions. HI-DRO Cushions maintenance costs per impact were less than those for Fitch Inertial Barriers, but initial costs of materials and installation were higher. The HI-DRO Cushion is generally more adaptable to narrow and relatively short areas than either the Fitch Inertial Barrier or the Steel Crash Cushion. Desirability of redirection capabilities is dependent upon site geometrics, traffic volumes, and speeds. If there is no feasible alternative, installation of an impact attenuating device is advocated in terms of warrants.

by J. G. Pigman; W. M. Seymour; D. L. Cornette  
 Kentucky Dept. of Highways, Lexington  
 Rept. No. RR-359; PB-221 848 ; 1973 ; 39p 15refs  
 Rept. on KYHPR-70-64, HPR-1(8), Pt 2. Prepared in  
 cooperation with the Federal Hwy. Administration.  
 Availability: Corporate author

HS-014 346

### **A FURTHER INVESTIGATION OF SYMBOL VERSUS WORD HIGHWAY SIGNS**

The glance legibility of symbol versus word message highway signs was studied using a 35 mm slide tachistoscope projector to present the subject with both kinds of signs, one at a time for an exposure duration of either 1/3 or 1/18 second. During a 10-second interference period, the subject was required to perform a simple reading task. Ten subjects were tested at the 1/3 second viewing time and 16 at the 1/18 second viewing time. All subjects, both drivers and nondrivers, were familiar with the wording signing system but only one had been previously exposed to the symbol system. The results show that under these laboratory test conditions, symbol signs are more effective in transmitting a message than are word signs.

by L. E. King; Z. J. George  
 West Virginia Univ., Morgantown; Department of the Navy,  
 Washington, D. C.  
 1971 ; 15p 7refs  
 Presented at the 15th Annual Human Factors Society Meeting,  
 New York, 18-21 Oct 1971.  
 Availability: Corporate authors

HS-014 347

### **HUMAN FACTORS DURING THE NEXT DECADE, 1970-1980**

Several areas important to the field of human factors are examined, including jet air transportation problems, private flying, automobile safety problems, passenger safety, urban planning, testing procedures, and product safety. It is concluded that there is great need for increased quantification of human factors data and the creation of data banks, and especially in human performance prediction, human reliability, and prediction of human error. Implications of the research are discussed.

by R. A. McFarland  
 Harvard School of Public Health, Boston, Mass.  
 1970 ; 24p 28refs  
 Presented at the 14th Annual Meeting of the Human Factors Society, San Francisco, 14 Oct 1970.  
 Availability: Corporate author

HS-014 348

### **STRATEGIES IN THE DESIGN AND EVALUATION OF ROAD SIGNS THROUGH THE MEASUREMENT OF DRIVER EYE MOVEMENTS**

Approaches developed for evaluating road signs by investigating sign-reading behaviors of drivers are described; The sign-reading behaviors were obtained by recording eye movements using an eye-marker system. Eye-movement data of five subjects were collected for over 200 different interstate signs under different driving conditions to determine values and

relationships between different measures that were developed to describe sign-reading behavior. The results show that differences in search and scan patterns can be attributed to signing differences and to factors related to drivers, highways, and traffic characteristics. Insights are given for designing new road signs by determining optimal degree of match between visual information display characteristics of road signs and the visual information acquisition behavior of drivers where trade-off relationship between population of drivers served by the signs and the signing costs need consideration.

by V. D. Bhise; T. H. Rockwell  
 Ohio State Univ., Columbus  
 1971 ; 13p 4refs  
 Presented at the Human Factors Society Meeting, New York,  
 Oct 1971.  
 Availability: Corporate author

HS-014 349

### **NEW DIRECTIONS IN AUTOMOBILE ACCIDENT RESEARCH**

Directions in driver accident behavior are reviewed, and it is concluded that an effective accident reduction strategy must rest upon an integrated approach. Improved highways and more crashworthy vehicles are important aspects, but significant gains can be realized also by a combined selection and training approach. Once the individual attributes are identified which contribute to accident involvement, then both training programs and vehicle and highway designs can be implemented to compensate for deficits in driver attributes.

by G. V. Barrett; R. A. Alexander  
 Rochester Univ., N. Y.  
 1972? ; 15p 30refs  
 Availability: Reference copy only

HS-014 350

### **ON THE RELATIONSHIP BETWEEN SPONTANEOUS AUTONOMIC ACTIVITY AND PERFORMANCE IN SEVERAL HIGHWAY DRIVING TASKS**

An approach to the problem of inter-subject variability in maximum performance achieved in several driving tasks and its relationship to spontaneous activity in the autonomic nervous system is considered. Spontaneous activity was measured in the laboratory while the subjects were resting, and subjects were assigned a number called the Autonomic Stability Rank, representing the combined spontaneous activity in heart rate and skin resistance. Seven male subjects participated in a driving experiment consisting of open road velocity production and maintenance, steady-state car-following, and transient car-following tasks. Linear regressions of the performance measures showed generally that performance tended to be better for subjects with high Autonomic Stability Rank statistics (persons with little or no spontaneous autonomic activity).

by R. F. Krenek  
Oklahoma Univ., Norman  
1971 ; 28p 10refs  
Presented at the 15th Annual Meeting of the Human Factors Society, New York, Oct 1971.  
Availability: Corporate author

HS-014 351

### **A STUDY OF EMERGENCY VEHICLE AUDITORY WARNING SIGNALS**

The incidence of accidents involving emergency vehicles such as ambulances, police cars, and fire engines was investigated by means of a national survey, and a problem was found to exist. Survey data indicated the need to study the effectiveness of warning sirens or other auditory signals commonly used. Actual experiments with emergency vehicles equipped with typical warning signals were conducted. Results indicate that such auditory signals have a very limited effectiveness in terms of the range at which they can be heard, and even when they are heard, the direction of approach can be correctly identified less than 50% of the time. Suggestions for alternative systems to be used for emergency vehicles are examined.

by J. L. Purswell; H. C. Aulwurm  
Oklahoma Univ., Norman  
1971 ; 33p 5refs  
Presented at the 15th Annual Meeting of the Human Factors Society, New York, Oct 1971.  
Availability: Corporate author

HS-014 352

### **FIELD OPERATIONS AND ENFORCEMENT MANUAL FOR AIR POLLUTION CONTROL. VOL. 2: CONTROL TECHNOLOGY AND GENERAL SOURCE INSPECTION**

Control technology and general source inspection guidelines are offered for emissions from both gasoline-powered and diesel-powered vehicles. Sources of exhaust emissions are reviewed, and typical vehicle emission control systems that may be checked by field enforcement officers are outlined; Types of visible vehicle emission violations include nuisance type and opacity type. Procedures for following and halting of vehicles by enforcement officers are given.

by M. I. Weisburd  
Pacific Environmental Services, Inc., Santa Monica, Calif.  
Contract CPA-70-122  
Rept. No. APTD-1101 ; 1972 ; 22p  
Prepared for System Development Corp., Santa Monica, and the Environmental Protection Agency, Research Triangle Park, N. C.  
Availability: Corporate author

HS-014 353

### **APPLICATIONS FOR SUSPENSION OF 1975 MOTOR VEHICLE EXHAUST EMISSION STANDARDS. APPENDIX C. ANALYSIS OF VEHICLE TEST DATA**

An analysis of vehicle emission test data submitted by applicants for a one-year suspension of the 1975 light-duty vehicle emission standards is presented. Information submitted by catalyst and substrate manufacturers, other automobile manu-

facturers, and manufacturers of engines other than spark ignition reciprocating engines was considered; Predictions as to the ability of individual manufacturers to meet the 1975 exhaust emission standards are set forth. Data analysis for eight individual manufacturers is included. The analysis concentrated on cars equipped with a typical 1975 emission control system, characterized by engine modifications, exhaust gas recirculation, air injection, and an oxidation catalyst; No analysis was performed on either diesel or rotary engines.

Environmental Protection Agency, Washington, D. C.  
1972 ; 72p  
Availability: Corporate author

HS-014 354

### **THE QUEST FOR A CLEAN MACHINE: IS EXTERNAL COMBUSTION THE ANSWER?**

External combustion engine designs, concepts depending on the burning of fuel outside the actual working engine, are discussed as an alternative to the internal combustion engine and as a solution to the exhaust pollution problem. Several designs are described: the Stirling engine, the steam engine, and various electric and hybrid electric designs. Benefits as well as economic and technological problems are examined;

by R. B. Overend  
Publ: Traffic Safety v74 n3 p22-24, 36, 38-40, 42 (Mar 1974)  
1974  
Availability: See serial citation

HS-014 355

### **SMALL-AREA DETECTION AT INTERSECTION APPROACHES**

Pertinent data and standards are reviewed, and the relationship between small area detector location and controller operation is examined. The detectors are those intended to detect vehicles at a spot location upstream of the stop bar, such as the pressure pad treadle detector and the 6-ft-long loop detector. Fundamentals of basic actuated controllers are described along with principal criteria for detector location. Actuated controllers are discussed, with the set-back put at three to four seconds of travel time, but not more than 120 feet. Those with advanced design are described, as well as their use in dilemma zones. Multiple-point detection, green extension systems, and queue discharge systems are also assessed.

Publ: Traffic Engineering v44 n5 p8-17 (Feb 1974)  
1974 ; 24refs  
See also HS-008 960.  
Availability: See serial citation

HS-014 356

### **ENERGY CHANGE NOISE: A MEASURE OF THE QUALITY OF FREEWAY TRAFFIC**

A parameter, energy-change noise, is proposed in an attempt to measure the quality of freeway traffic. It is defined as the standard deviation of the changes in kinetic energy of a vehicle as it travels through a section of the roadway. The development of the parameter is based on the theoretical consideration that the magnitude and frequency of kinetic energy changes of a vehicle provides valuable information on

the quality of service provided by traffic. The assumption is similar to the acceleration noise parameter, which takes into consideration the magnitude and frequency of velocity changes. Mathematical derivations are given.

by J. Lee; J. C. Yu  
Publ: Traffic Engineering v44 n5 p28-35 (Feb 1974)  
1974 ; 5refs  
Availability: See serial citation

HS-014 357

### **AN ANALYSIS OF DRINKING AND DRIVING SURVEY DATA**

Two surveys of representative samples of adults of driving age in Washtenaw County, Michigan were conducted in 1971 and 1973 to obtain baseline and comparison data on knowledge, attitudes, and behavior concerning alcohol use and driving-after-drinking. Interviews were obtained from 606 respondents in 1971 and 619 in 1973. A comparison of the findings shows a substantial increase in reported alcohol use from 1971 to 1973 among age groups under 35, and shows for the 18-20 newly legalized drinkers a considerable increase. For other age groups, it shows no decrease in the amount of driving after excessive drinking, but some increase in the use of alternative means of transportation after drinking too much. Few significant changes in attitude and knowledge were found except for an increase in awareness of the Washtenaw County Alcohol Safety Action Project.

by A. C. Wolfe; M. M. Chapman  
Contract Ref: FH-11-7535  
Publ: HIT LAB Reports v4 n4 p1-5 (Dec 1973)  
1973 ; 5p  
Adapted from a rept. prepared for the Washtenaw County,  
Mich. Board of Commissioners.  
Availability: See serial citation

HS-014 358

### **HIGH SCHOOL STUDENT DRINKING AND DRIVING BEHAVIOR**

Surveys of senior high school students in Washtenaw County, Michigan were conducted in 1970-71 and 1972-73 on drinking and driving behavior. There were 436 students in the first survey, 589 in the second. Alcohol use increased from 66% of the respondents in 1970 to 76% in 1972. Greater quantities as well as greater frequencies of alcohol consumption were indicated. In addition, 39% of 1972 respondents reported smoking marijuana and 20%, hashish. Few significant changes in driving-after-drinking behavior, and knowledge and attitudes on drinking and driving were found. It is concluded that the Washtenaw County Alcohol Safety Action Project had little impact on Washtenaw County high school students.

by A. C. Wolfe; M. M. Chapman  
Contract REF: FH-11-7535  
Publ: HIT LAB Reports v4 n4 p6-13 (Dec 1973)  
1973 ; 8p 1ref  
Adapted from a rept. prepared for the Washtenaw County,  
Mich. Board of Commissioners.  
Availability: See serial citation

HS-014 359

### **TURBINE-ELECTRIC TRACTOR-TRAILER TEST RIG**

Tests of an electrically propelled tractor-trailer with power on all axles are described. The test rig showed superior performance over standard tractor-trailer vehicles of the same size and power on highways, beaches, and hills; It demonstrated that electric propulsion for heavy-duty applications can perform well in on-road and off-road applications. It can also be made cost effective by utilizing commercially available electrical equipment.

by D. J. Roesler; L. D. Gaddy, Jr.  
Army Mobility Equipment Res. and Devel. Center, Fort Belvoir, Va.  
Rept. No. SAE-730748 ; 1973 ; 11p 5refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 73.  
Availability: SAE

HS-014 360

### **THE LAW AND THE ON-OFF HIGHWAY TRUCK**

The effect of state weight laws in Wisconsin, Indiana, Louisiana, Illinois, and California on the mixer truck axle configuration is reviewed; Design changes necessitated by the federal brake law (FMVSS 121) including the dynamic weight transfer problem, are examined. Consideration is also given to the expected design changes to attenuate the noise emission of the mixer truck. Action by the Society of Automotive Engineers in examining and coordinating proposed new federal regulations is advocated.

by R. Denes  
Oshkosh Truck Corp., Wis.  
Rept. No. SAE-730750 ; 1973 ; 10p 3refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 361

### **DESIGN AND APPLICATION OF SKIDOZER SNOWMOBILE TRAIL GROOMING EQUIPMENT**

New tracked vehicles and accessory equipment designed to groom snowmobile trails effectively and at a reasonable cost are described. Emphasis is on snowmobile trail criteria, parameters of the Skidozer design (performance on snow, traction, ruggedness, power, low maintenance, comfort, reliability, and vehicle models and specifications), and parameters of groomer design. Results from grooming trails are discussed.

by N. Carpentier  
Bombardier Ltd., Valcourt, Que. (Canada)  
Rept. No. SAE-730755 ; 1973 ; 13p 2refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 362

### **DESIGN AND INSTALLATION OF ROPS FOR ARMY RETROFIT PROGRAM**

The U. S. Army is faced with the requirement to provide Rollover Protective Structures (ROPS) on new and old construction equipment vehicles. Many of the commercial design practices can be followed but some military design features and operational conditions pose unusual problems. The large number of vehicles involved and the wide distribution made it necessary to study the problems and ramifications for each machine. New techniques of design and evaluation had to be developed to cover the major constraints of previously built machines. New design features have been incorporated into the ROPS to simplify shipment, visibility, and retrofit, including refinements on the two-post ROPS, mesh design for falling objects, and mounts.

by P. D. Hopler; W. O. Stewart  
Army Mobility Equipment Res. and Devel. Center, Fort Belvoir, Va.  
Rept. No. SAE-730752 ; 1973 ; 8p 4refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 363

### **DESIGN AND DEVELOPMENT OF THE KITTY CAT CHILD'S SNOWMOBILE**

The design of the Kitty Cat child's snowmobile is traced from the initial concept stage through final production. The concept is taken through three distinct designs, with prototypes constructed at each stage. Objectives were established before finalization, and design parameters were developed. The most important of these, maximum operator safety, is elaborated upon. A broad-range testing program and technical innovations are discussed. The design of the project itself is also treated as an item of special interest.

by W. A. Wood  
Arctic Enterprises, Inc., Thief River Falls, Minn.  
Rept. No. SAE-730756 ; 1973 ; 5p  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 364

### **DYNAMIC TESTING OF TRACTOR PROTECTION CABS--DEVELOPMENT OF METHOD, PRACTICAL EXPERIENCES**

Studies on and tests for tractor protection frames or cabs are reported. Principles and energy values of dynamic tests are

discussed as well as OEDC and ISO activities in establishing standards. Swedish practical experiences show a large decrease in fatalities as a result of these studies.

by H. A. Moberg  
Statens Maskinprovningar, Uppsala (Sweden)  
Rept. No. SAE-730761 ; 1973 ; 12 2refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 365

### **NEBRASKA TRACTOR TEST--PROGRAMS AND PHILOSOPHY**

Procedures used in testing agricultural tractors are outlined, and other test laboratory results are compared with those from the Nebraska Tractor Test Laboratory. Tests are conducted to determine the maximum horsepower at maximum power takeoff, maximum horsepower in operating gears, maximum pull available from the machine, and noise level at the operator station. These tests showed that a difference of roughly 6% resulted between the testing procedures, which could not be accounted for. It is hoped that testing procedures at different testing stations can be coordinated to improve the tests and tractor performance.

by W. E. Splinter; G. W. Steinbruegge; D. E. Lane, L. F. Larsen  
Nebraskas Univ., Lincoln  
Rept. No. SAE-790763 ; 1973 ; 7p 1ref  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 366

### **A RELIABILITY ORIENTED APPROACH TO THE DESIGN OF OFF-HIGHWAY STEERING SYSTEMS**

Four different off-highway truck hydraulic steering systems with varying complexity are presented. The reliability of each type of system is compared showing the effects of redundancy of components. The importance of system configuration is brought out to offset the adverse effects of a low reliability component. The advantages of a stored energy system in providing an emergency steering capability and in reducing the size of the pump are discussed.

by D. Webb  
Westinghouse Air Brake Co., Pittsburgh, Pa.  
Rept. No. SAE-730769 ; 1973 ; 10p  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 367

### **PERFORMANCE TESTING AND CRITERIA FOR SNOWMOBILE SEAT CUSHIONS**

A reliable and practical test method developed to measure the dynamic cushioning properties of snowmobile seats is discussed. These cushioning properties are related to probabili-



ty of spinal injury to man impacting such cushions, and minimum performance levels are recommended. This test method and relation of data to injury probability provides the engineer the tool with which to design safety scientifically into snowmobile seat cushions.

by L. R. Schanhals; R. L. Pershing  
Dow Chemical Co., Midland, Mich.; Deere and Co., Dubuque, Iowa  
Rept. No. SAE-730770 ; 1973 ; 9p 12refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 368

### **EXTERIOR SOUND LEVEL FOR SNOWMOBILES FROM SAE J192 TO SAE J192A--BACKGROUND AND INSIGHT**

The environmental impact of snowmobile noise is discussed and the need for a satisfactory and repeatable measurement practice is noted. The reasoning behind the SAE J192 Recommended Practice is described, along with the facilitation of collection and interpretation of associated test data. Test procedure parameters include measurement of maximum noise capability, regardless of the normal operating mode, and no allowances made for unusual and potentially noisy components, such as snowmobile tracks. Recommendations are offered for testing surface, instrumentation, fixed acceleration distance, test procedure, standardization, dB tolerances, proper machine use, applicable dB range, and other test method possibilities.

by K. F. Nowak  
ACS Ltd., Don Mills, Ont. (Canada)  
Rept. No. SAE-730773 ; 1973 ; 7p 8refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 369

### **THE SEQUENCE IIC RUST TEST PROCEDURE**

The Sequence IIB rust test procedure did not provide sufficient differentiation among better quality SE engine oils, so a new, more severe test, Sequence IIC, was developed. Its results are about one-half rust rating number lower than Sequence IIB results. Sequence IIC results correlate very well with short-trip car data obtained with either leaded or unleaded gasoline. The location and amount of rust and/or discoloration observed on lifters from short-trip car tests, conducted with either leaded or unleaded gasoline. The procedure has sufficient sensitivity to show performance changes with relatively small changes in additive concentration. Improved rust rating techniques are advocated.

by R. H. Kabel  
General Motors Res. Labs., Warren, Mich.  
Rept. No. SAE-730779 ; 1973 ; 16p 25refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 370

### **THE EFFECT OF FUEL COMPOSITION ON LUBRICANT DEGRADATION RATES IN A SPARK IGNITED ENGINE**

The effect of pure fuels and several mixtures of pure fuels on lubricant degradation rates was determined by burning them in a CLR engine fitted with a Cu-Pb bearing and operated at high speeds and high crankcase temperatures. Oil degradation rates were measured by infrared analysis and the rate of corrosion of the Cu-Pb bearing by oil analysis for copper. Fuels stressed the lubricant in the following decreasing order: diisobutylene, isooctane, decene-1, hexene-1, cumene, benzene 0 tert-butylbenzene, xylenes, toluene. The lubricant responded to mixtures of these fuels in a manner predictable from the response to pure fuels. The generally low stresses applied to the lubricant by the aromatic fuels may be attributed to the antioxidant action of phenols formed during fuels may be attributed to the antioxidant action of phenols formed during combustion. No mechanism was established for the markedly lower stresses observed with the methyl-substituted aromatics.

by M. A. McMahon; K. L. Kreuz  
Texaco, Inc., New York  
Rept. No. SAE-730780 ; 1973 ; 7p 7refs  
Presented at the National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, 10-13 Sep 1973.  
Availability: SAE

HS-014 371

### **PROCEEDINGS OF SEVENTEENTH STAPP CAR CRASH CONFERENCE, NOVEMBER 12-13, 1973, OKLAHOMA CITY, OKLAHOMA**

Conference papers are presented on various effects and evaluations of automobile collisions. Four major subject areas are included: collision injuries and mechanisms, evaluation of protective systems, human tolerance and collision analysis, and anthropometry and dummy development.

Society of Automotive Engineers, Inc., New York  
1973 ; 541p refs  
Includes HS-014 372--HS-014 394. Sponsored by the Biomechanics Res. Center, Wayne State Univ., Michigan Univ., and California Univ., San Diego.  
Availability: Corporate author

HS-014 372

### **PASSENGER INJURIES IN COLLISIONS AND THEIR RELATION TO GENERAL SPEED SCALE**

Injuries of car occupants were studied on the basis of representative material comprising 29,000 accidents. The relative collision speed (RCS) was defined, and its importance as a categorizing method is discussed in relation to the equivalent

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test speed in crash tests. The frequency of actual accidents with regard to five typical accident categories and the resulting passenger injuries are indicated. The influence exercised by the vehicle mass, its deformation characteristics, its turning away movement in collision, and its interior safety are compared in accidents involving four typical vehicle categories. The benefits of seat belt usage is shown. The collision speeds of 94 frontal accidents with fatal injuries to occupants are discussed. The speed at which safety tests for typical accident categories are to be carried out in order to include 90% of all accidents is specified.

by K. Langwieder  
HUK-Verband (West Germany)  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p1-34  
Rept. No. SAE-730963 ; 1973 ; 9refs  
Availability: In HS-014 371

HS-014 373

### **SEAT BELTS--LIMITS OF PROTECTION: A STUDY OF FATAL INJURIES AMONG BELT WEARERS**

A series of fatally injured occupants of recent-model passenger cars is studied to determine the potential for extension of the limits of seat belt performance in crashes that are currently fatal. Improvements in seat belt design and installation should reduce a proportion of current losses from death and injury, but further reductions in these losses will demand attention not only to the crashworthiness of the car but also to the characteristics of the other vehicles and roadside structures that are commonly impacted.

by J. M. Henderson; J. M. Wyllie  
New South Wales Dept. of Motor Transport, Sidney (Australia)  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p35-66  
Rept. No. SAE-730964 ; 1973 ; 17refs  
Availability: In HS-014 371

HS-014 374

### **A STUDY OF SEAT BELTS AND INJURIES**

The effects of wearing seat belts in severe crash impacts in Victoria, Australia are studied. It is found that there are some injuries associated with wearing seat belts, but most minor. There is an association between incorrect adjustment of seat belts and the occurrence of injury, and there is a need for seat belt systems to be foolproof so that they can only be worn correctly.

by G. A. Ryan  
Monash Univ., Clayton, Vic. (Australia)  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p67-79  
Rept. No. SAE-730965 ; 1973 ; 5refs  
Availability: In HS-014 371

HS-014 375

### **FRACTURE MECHANISM OF LOWER LEGS UNDER IMPACT LOAD**

The mechanism of injuries of the tibia under dynamic load conditions is reported. Some 209 tests with cadavers represent-

ing the normal pedestrian population were carried out on a twin-pendulum catapult. Point of impact was varied between the patella and the distal end of the tibia. Pathological dissection and digital computer evaluation showed the relation between the mechanical and biological properties of the test specimens. The breaking forces are shown as a function of impact velocity as well as the particulars of the injuries, depending upon physiological parameters describing critical limits, from which the risk of being severely injured will sharply rise. The relation between mechanical and physiological parameters allow estimation of the severity of real-world injuries through the dummy tests.

by M. Kramer; K. Burow; A. Heger  
Technische Univ., Berlin (West Germany)  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p81-100  
Rept. No. SAE-730966 ; 1973 ; 3refs  
Availability: In HS-014 371

HS-014 376

### **RESPONSE OF HUMAN LARYNX TO BLUNT LOADING**

A multidisciplinary study to determine the response of unembalmed human larynges to blunt mechanical loading and to interpret the response with respect to clinical data is described. Fresh intact larynges were obtained at autopsy and tested at either static or dynamic loading conditions utilizing special test fixtures in materials-testing machines. Load and deformation data were obtained up to levels sufficient to produce significant fractures in both the thyroid and cricoid cartilages. Additional information was obtained in the form of permanent dimensional changes through direct measurements and fracture site location by xeroradiography. Final evaluation of the damage was performed following dissection of the laryngeal structure. The results are analyzed and interpreted in relation to establishing tolerance criteria for laryngeal loading.

by J. W. Melvin; R. G. Snyder; L. W. Travis; N. R. Olson  
Michigan Univ., Ann Arbor  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p101-14  
Rept. No. SAE-730967 ; 1973 ; 5refs  
Availability: In HS-014 371

HS-014 377

### **IMPACT INJURY MECHANISMS IN ABDOMINAL ORGANS**

Blunt abdominal trauma is studied in impact tests of livers and kidneys performed in a high-speed testing machine at a controlled ram velocity and stroke limit. The organ was surgically mobilized in anesthetized Rhesus monkeys and then placed on a load cell while still being perfused in the living animal. Load-deflection data were normalized and average stress-strain curves plotted. The resulting injury severity was estimated immediately after impact using an injury scale of 1 to 5. The observed injury mechanism is discussed, and correlation between injury severity and the mechanical parameters of stress, strain, and strain energy produced in the tissue of the organ is presented.

by J. W. Melvin; R. L. Stalnaker; V. L. Roberts; M. L. Trollope  
Michigan Univ., Ann Arbor  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York 1973 p115-26  
Rept. No. SAE-730968 ; 1973 ; 6refs  
Availability: In HS-014 371

HS-014 378

## IMPROVED LAMINATED WINDSHIELD WITH REDUCED LACERATION PROPERTIES

A laminated automobile windshield called Triplex Ten-Twenty, biochemically evaluated using a dropping headform and skull impactor, and a 50th percentile anthropomorphic dummy in sled tests, is described. The results of these evaluations at velocities up to 60 km/h are expressed in terms of Gadd index, head injury criterion, and various laceration scales including the Triplex laceration index (TLI). Some details are also given of other properties of the windshield. The results of the evaluations indicate the the Ten-Twenty windshield offers a reduction of about two units on the TLI scale equivalent to a 99% reduction in the number (or 90% reduction in length) of cuts when the length and depth of cuts remain unaltered, or a change in depth of cuts from one layer of skin simulation to another.

by S. E. Kay; J. Pickard; L. M. Patrick  
Triplex Safety Glass Co. Ltd., Birmingham (England); Wayne  
State Univ., Detroit, Mich.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p127-69  
Rept. No. SAE-730969 ; 1973 ; 6refs  
Availability: In HS-014 371

HS-014 379

## CONCUSSION LEVELS DETERMINED BY HPR WINDSHIELD IMPACTS

Accident restaging was used to determine the head impact level that will produce concussion in humans. Examination of accident records show that the percentage of victims receiving a concussion involving known unconsciousness reduces to 11% in the case of radial crack with bulge; 2.8% for radial crack with no bulge. Several head injury indexes were calculated from cadaver head acceleration tests and the calculated criteria were either approximately equal or greater for the no-bulge windshield condition than the bulged condition. For the cadaver data, the indexes focused on the spike caused by the glass breakage, and for dummy data, on the broad pulse resulting from the interlayer bulging. This difference arose from the fact that the cadavers produced lower accelerations during the bulge event than did dummies.

by V. R. Hodgson; L. M. Thomas; J. Brinn  
Wayne State Univ., Detroit, Mich.; Chrysler Corp., Detroit,  
Mich.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p171-90  
Rept. No. SAE-730970 ; 1973 ; 8refs  
Availability: In HS-014 371

HS-014 380

## IMPROVED LAMINATED WINDSCREENS BY ENERGY-CONTROLLED BREAKOUT

An improved laminated windshield is described which exhibits energy controlled breakout at the fixed edge, working at an impact speed of more than 20 mph. The performance of the head impact against the windshield as well as the energy reaction between the head and the glass were studied in 70 tests, with impact velocity raised from 15 to 37 mph. Head decelerations are not essentially lower than those of conventional windshields, but there is a smoother rise of the deceleration time-history due to breakoff at the edge. There are hardly any penetrations or long ruptures of the interlayer, compared to more than 50% in normal types. The very low amount of residual kinetic energy of the head after its impact onto the windshield indicated the improved safety performance.

by M. Kramer  
Technische Univ., Berlin (West Germany)  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p191-217  
Rept. No. SAE-730971 ; 1973 ; 8refs  
Availability: In HS-014 371

HS-014 381

## EVALUATION OF AUSTRALIAN CHILD RESTRAINTS

The dynamic performance of child restraints available in Australia is examined from engineering and medical points of view. Dynamic collision simulations were carried out with restraints having the approval of the Standards Association of Australia. Frontal and side impacts were simulated to allow measurement of space requirements and appraisal of the forces applied to the passenger using each restraint. Strengths and weaknesses of the various types of device are explored and conclusions are reached about the crash protection available to children in Australia. The principal doubt about the crash protection offered by the restraints is in the way they restrain the immature lower torso of the young child.

by D. C. Herbert; B. A. Vazey; J. M. Wyllie; R. G. Vaughan;  
N. Leitis  
New South Wales Dept. of Motor Transport, Sidney  
(Australia)  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p219-44  
Rept. No. SAE-730972 ; 1973 ; 18refs  
Availability: In HS-014 371

HS-014 382

## THE GM CHILD LOVE SEAT

The design and development of the General Motors Love Seat

by a five-belt harness system that utilizes a single quick-release buckle. The seat is restrained by the vehicle lap belts and a top anchor strap. It meets the standards of FMVSS 213 in static testing, and it reduces excursion of the child in front and side impact testing. The seat has padded forward-projecting walls at the side of the head. It retained its integrity during impact testing.

by J. P. Makinen; N. Feles; L. P. Garvey  
General Motors Corp., Warren, Mich.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p245-58  
Rept. No. SAE-730973 ; 1973 ; 3refs  
Availability: In HS-014 371

HS-014 383

### **MATCHED DRIVER RESTRAINT SYSTEMS**

A velocity-sensitive absorber is introduced that is intended to provide the required dissipation within recommended force limits. It is shown that retention of current typical compartment dimensions suggests that the stroke required at speeds near 60 mph will be difficult to accommodate. Illustrative examples of the velocity-sensitive restraint subjected to the deceleration pulse of a vehicle having an energy management structure are presented. Special features include a deployable hydraulic energy absorber and an absorber that permits lateral motion of the occupant. It is shown that: a velocity-sensitive device can complicate the masses can be developed; a velocity-sensitive device can complicate the conventional view of ride-down enhancement; passive and active speeds can be made effective at 50 mph; and energy management vehicle structures are compatible with postulated restraint characteristics.

by F. A. DuWaldt  
Calspan Corp., Buffalo, N. Y.  
Contract DOT-FH-11-7622  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p259-83  
Rept. No. SAE-730974 ; 1973 ; 11refs  
Availability: In HS-014 371

HS-014 384

### **CERVICAL RANGE OF MOTION AND DYNAMIC RESPONSE AND STRENGTH OF CERVICAL MUSCLES**

Basic physical characteristics of the neck have been defined which have application to the design of biomechanical models, anthropomorphic dummies, and occupant crash protection devices. Measurements from 180 volunteer subjects included anthropometry, cervical range-of-motion, the dynamic response of the cervical flexor and extensor muscles to a controlled jerk, and the maximum voluntary strength of the cervical muscles. Data are presented in tabular and graphic form for total range-of-motion, cervical muscle reflex time, decelerations of the head, muscle activation time, and cervical muscle strength. Age and sex were found to be important factors in cervical flexibility and response characteristics and should be included for accuracy in neck parameters.

by D. R. Foust; D. B. Chaffin; R. G. Snyder; J. K. Baum  
Michigan Univ., Ann Arbor  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p285-308  
Rept. No. SAE-730975 ; 1973 ; 18refs  
Sponsored by The Insurance Inst. for Hwy. Safety, Washington, D. C.  
Availability: In HS-014 371

HS-014 385

### **TORQUE VERSUS ANGULAR DISPLACEMENT RESPONSE OF HUMAN HEAD TO -G sub x IMPACT ACCELERATION**

The results are discussed of a comparison of 41 previously reported test runs and human volunteer runs performed by Mertz and Patrick in testing torque versus angular displacement response of the human head to -G sub x impact acceleration. Due to different instrumentation and measuring techniques, there were several differences, but large portions of the data were comparable. The need for anatomically based three-dimensional coordinate systems to permit quantitative comparisons between human subjects is suggested.

by C. L. Ewing; D. J. Thomas  
Naval Aerospace Medical Res. Lab., Pensacola, Fla.  
Contract DOT-HS-187-2-295  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p309-42  
Rept. No. SAE-730976 ; 1973 ; 12refs  
Availability: In HS-014 371

HS-014 386

### **SPINAL LOADS RESULTING FROM -G sub x ACCELERATION**

The biodynamic response of cadaver torsos subjected to -G sub x impact acceleration is discussed, with particular emphasis given to the response of the vertebral column. The existence of an axial force along the spine and manifestation as a load on the seat pan are reported. Spinal curvature appears to be an important factor in the generation of this spine load. In anthropomorphic dummies, the spine load does not exist. Details of the testing and results are given, and the development of a mathematical model is shown.

by P. C. Begeman; A. I. King; P. Prasad  
Wayne State Univ., Detroit, Mich.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car Crash Conference, New York, 1973 p343-60  
Rept. No. SAE-730977 ; 1973 ; 16refs  
Availability: In HS-014 371

HS-014 387

### **FLASH X-RAY CINEMATOGRAPHY DURING IMPACT INJURY**

Flash x-ray cinematography techniques and equipment used to record high-speed motions occurring during impact injury are discussed. Cineangiographic studies of the aortic arch, cardiac ventricle, and intracranial arteries are presented. X-ray cinematography systems and various high-speed applications of them are reviewed briefly, and the need for quantitative information of visceral and vascular movements during impact trauma is emphasized.

by S. A. Shatsky  
 Armed Forces Radiobiology Res. Inst., Bethesda, Md.  
 Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
 Crash Conference, New York, 1973 p361-76  
 Rept. No. SAE-730978 ; 1973 ; 18refs  
 Availability: In HS-014 371

HS-014 388

## **SIDE IMPACT TOLERANCE TO BLUNT TRAUMA**

A series of living primate side impacts to the head and torso was conducted in parallel with a series of impacts to human cadavers. Dimensional analysis techniques were used to estimate in vivo human tolerance to side injury. The threshold of closed brain injury to humans was found to be 76 g for a pulse duration of 20 ms and an impact velocity of 43 ft/s. The maximum tolerable penetration to the chest was found to be 2.65 in for both the left and right sides. Scaling of abdominal injuries to human was accomplished by using a factor that relates impact contact area, animal mass, impact force, and pulse duration to injury severity. The maximum tolerable contact pressure to the upper abdomen of a human was found to be 32 lbf/in squared.

by R. L. Stalnaker; V. L. Roberts; J.H. McElhaney  
 Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.  
 Contract DOT-HS-031-2-382  
 Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
 Crash Conference, New York, 1973 p 377-408  
 Rept. No. SAE-730979 ; 1973 ; 14refs  
 Availability: In HS-014 371

HS-014 389

## **COMPUTER PROGRAM FOR RECONSTRUCTION OF HIGHWAY ACCIDENTS**

The Simulation Model of Automobile Collisions (SMAC) computer program, which achieves uniformity in the use of analytical techniques for interpretation of physical evidence in investigations of highway accidents, is discussed. SMAC's comprehensive output information (kinematics, tire tracks, and vehicle damage) permits extensive comparisons with physical evidence in the iterative runs used to achieve a best fit, and the predicted vehicle responses provide a basis for relatively refined categorization of occupant exposures. The analytical approach is outlined, and specific assumptions are defined. Comparisons are presented between analytical predictions and results of staged collisions, and results of sample applications to actual highway accidents are included. Computer graphic displays of reconstructed accidents are also presented.

by R. R. McHenry  
 Calspan Corp., Buffalo, N. Y.  
 Contract FH-11-7526; DOT-HS-053-1-146  
 Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
 Crash Conference, New York, 1973 p409-35  
 Rept. No. SAE-730980 ; 1973 ; 13refs  
 Availability: In HS-014 371

HS-014 390

## **THORACIC IMPACT: NEW EXPERIMENTAL APPROACHES LEADING TO MODEL SYNTHESIS**

Thoracic impact experiments were performed on carcasses of freshly sacrificed swine on which accelerometers were fastened to the sternum and backbone at the level of the fourth intercostal space. The carcasses were impacted by a ram in the manner of previous cadaver work, subjected to short-duration, free-vibration impacts to the sternum, and dropped into a shallow pool of water from heights up to 9.1 m (30 ft) to simulate the severe frontal impact sustained by a stunt driver. The acceleration ratios were noted, and the acceleration traces were integrated to obtain chest deflection and Fourier analyzed for harmonic content. The air pressure in the lung was also monitored during one series of ram and free-vibration experiments. It was found that air in the lung at impact does not escape immediately, acceleration readings from any single region of the thorax are unreliable indexes of severity, and a single transfer function is inadequate to describe the chest for all loading conditions.

by R. M. Schreck; D. C. Viano  
 General Motors Res. Labs., Warren, Mich.  
 Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
 Crash Conference, New York, 1973 p437-50  
 Rept. No. SAE-730981 ; 1973 ; 7refs  
 Availability: In HS-014 371

HS-014 391

## **MECHANICAL SIMULATION OF HUMAN THORAX UNDER IMPACT**

An analysis, design, and test project in which a dummy chest structure was developed is summarized. The chest consisted of mechanical elements that had been characterized by computer simulations as giving responses to blunt frontal impacts necessary for biofidelity. An analysis of mechanical rib structures indicated that materials having a high ratio of yield stress to modulus of elasticity were required. A mechanical system was developed with steel ribs pivoted at each end as a primary spring. A secondary spring was a pair of commercially available die springs acting in parallel with the ribs after 25.4 mm deflection. A fluid damper was developed to provide the damping. Testing showed that the system satisfied the 4.92 m/s (16 mph) response corridor and was very near the 7.15 m/s (16 mph) corridor. Further adjustments are necessary to adapt the chest to a crash test dummy.

by R. F. Neathery; T. E. Lobdell  
General Motors Res. Labs., Warren, Mich.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p451-66  
Rept. No. SAE-730982 ; 1973 ; 8refs  
Availability: In HS-014 371

HS-014 392

### **A NEW CRASH TEST DEVICE--"REPEATABLE PETE"**

A new crash test device has been developed called Repeatable Pete. It is a repeatable, durable anthropomorphic dummy with humanlike dynamic performance. The device is examined with details given of its design and performance during testing in automotive situations. The head, neck, and chest match the latest biomechanical information on the dynamic response of unembalmed cadavers. The head c.g. accelerations adequately match the skull acceleration, so that head injury criteria based upon cadaver skull acceleration may be used.

by J. H. McElhaney; P. I. Mate; V. L. Roberts  
Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p467-507  
Rept. No. SAE-730983 ; 1973 ; 12refs  
Availability: In HS-014 371

HS-014 393

### **FEMUR LOAD INJURY CRITERIA--A REALISTIC APPROACH**

An analysis is presented which indicates that while 1700 lbf is a realistic femur fracture load for 30-50 ms duration impacts, the human femur can withstand higher loads for shorter duration impacts. Experimental femur fracture data from cadaver and bone specimen tests are reviewed, and are used to develop femur load fracture tolerance as a function of impact duration. On the basis of a measured 10% amplification of 1-2 ms input forces by the dummy, the cadaver fracture tolerance is proportionately adjusted to arrive at equivalent load levels for forces measured on current dummy test devices. Experimental dummy test device data are included and compared to the theoretical response of a mathematical model of the human upper leg. This comparison demonstrates that there are significant differences in dummy and human upper leg responses for impact durations less than 3 ms.

by J. J. King; W. R. S. Fan; R. J. Vargovick  
Ford Motor Co., Dearborn, Mich.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p 509-24  
Rept. No. SAE-730984 ; 1973 ; 10refs  
Availability: In HS-014 371

HS-014 394

### **MASS, VOLUME, CENTER OF MASS, AND MASS MOMENT OF INERTIA OF HEAD AND HEAD AND NECK OF HUMAN BODY**

The mass, volume, center of mass, and mass moment of inertia of the head and the neck were determined for 20 human male cadavers. Anthropometric values and anatomic landmarks were obtained by external measurements and by use of

x-ray procedures. The procedures used to determine those measurements are described. Uniform planes for the separation of the head and neck from the torso and separation of the head from the neck were established and are described in detail. The values of the physical properties of the head and neck and the head are tabulated and compared to data reported in previous studies.

by L. B. Walker, Jr.; E. H. Harris; U. R. Pontius  
Tulane Univ., New Orleans, La.  
Publ: HS-014 371, Proceedings of Seventeenth Stapp Car  
Crash Conference, New York, 1973 p525-37  
Rept. No. SAE-730985 ; 1973 ; 13refs  
Availability: In HS-014 371

HS-014 395

### **EUROPEAN TECHNOLOGY TRENDS**

Trends in the European automobile industry are discussed. It is noted that design innovations have traditionally been regarded as the answer to specific problems of European driving, but that changes due to desire for more luxury are also being made. Consideration is given to the success of radial-ply tires, steel-belted radials, glass fiber tires, windshield defogging, disc brakes, anti-lock braking systems, the Fabrostrip method wiring, radar warning systems, automatic transmissions, suspension systems, the Wankel rotary engine, body construction, and the Stirling engine.

by P. J. Mullins  
Publ: Automotive Industries v150 n5 p25-9 (1 Mar 1974)  
1974  
Availability: See serial citation

HS-014 396

### **RESEARCH AND THE IMPROVEMENT OF TYRE PERFORMANCE**

Several aspects of research which are either directly or indirectly concerned with improving natural rubber's position in the tire field are discussed. Emphasis is placed on performance improvement, such as ice friction qualities, heat build-up, cutting, tearing and flaking, and abrasion and wear characteristics. Specific consideration is given to liquid rubber, thermoplastic rubbers, and urethane vulcanization, which has special advantages for natural rubber, especially in heavy-duty tires.

by J. I. Cunneen  
Publ: NR Technology v4 pt4 p65-75 (1973)  
1973 ; 10refs  
Based on a paper given at the IRRDB Conference at Puncak, Indonesia, Jul 1973.  
Availability: See serial citation

HS-014 397

### **THE EFFECTIVENESS OF VIDEO TAPE FEEDBACK ON DRIVING PERFORMANCE AND SELF-EVALUATION**

Sixty subjects were pre-tested with a written adapted version of the McGlade Road Test to determine individual ratings of driving competencies. Each subject then drove a station wagon equipped with a video tape recording system and special in-

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Instrumentations in two separate sessions, after which one of four feedback conditions was received: self-evaluation via video tape only; teacher critique only; both; no feedback. Self-ratings were made at a third session. Results showed no positive relationship between the examiner's and the driver's rating of the performance. None of the treatments significantly affected the differences in the drivers' self-evaluation from pre-test to post-test. Subjects who evaluated their driving via tape and teacher critique scored significantly higher on the combined road test scores.

by J. J. Pease; C. F. Damron

Publ: Journal of Safety Research v6 n1 p34-40 (Mar 1974)

1974 ; 19refs

Sponsored by the National Safety Council's Exploratory Res. Grants Review Committee. Based on doctoral dissertation of J. J. Pease, Wisconsin Univ.

Availability: See serial citation

HS-014 398

### THE MOTORCYCLE/BICYCLE SAFETY ANALOGY

The injury vulnerability of motorcyclists and bicyclists and cycle safety in general are discussed. The prevalence of collisions with motor vehicles is noted, and it is found that motorcyclists are less often at fault than bicyclists. The lax treatment of bicycle law offenders is described, and educational programs to change attitudes and behavior is recommended. The need for study and revision of bicycle regulations is also suggested. Further guidelines are offered for making cycles more conspicuous, such as colored helmets and vests, flags, reflective materials, and lighting. Defensive driving education is advocated, and various kinds of common road hazards are described. Special bikeway facilities are also reported.

by L. S. Buchanan

National Hwy. Traf. Safety Administration, Washington, D. C. 1973 ; 9p

Presented at the Bicycles U. S. A. Conference, Cambridge, Mass., 7 May 1973.

Availability: Corporate author

HS-014 399

### ELECTRIC VEHICLE BATTERY RESEARCH AND DEVELOPMENT

Interest in and the need for the electric car are discussed, with emphasis focused on research and development of the electric vehicle battery. The problem of air pollution from exhaust emissions is stressed, along with the dwindling energy supply. State-of-the-art studies of the battery are reviewed, including conventional batteries, metal-gas batteries, alkali metal-high temperature batteries, and other approaches. It is noted that battery technology for electric vehicles is not advancing rapidly because of a general lack of support on the parts of both Government and private industry. Outlook for the future is given.

by H. J. Schwartz

Lewis Res. Center, Cleveland, Ohio

Rept. No. NASA-TM-X-71471; N74-10946 ; 1973 ; 18p 12refs

Presented at the Electrochemical Society Meeting, Boston, 7-11 Oct 1973.

Availability: NTIS

HS-014 400

### A SYSTEMATIC EXPERIMENTAL INVESTIGATION OF SIGNIFICANT PARAMETERS AFFECTING MODEL TIRE HYDROPLANING

The results of a comprehensive parametric study of model and small pneumatic tires operating on a wet surface are presented. Hydroplaning inception (spin down) and rolling restoration (spin up) are discussed. Conclusions indicate that hydroplaning inception occurs at a speed significantly higher than the rolling restoration speed. Hydroplaning speed increases considerably with tread depth, surface roughness, and tire inflation pressure or footprint pressure, and only moderately with increased load. Water film thickness affects spin down speed only slightly. Spin down speed varies inversely as approximately the one-sixth power of film thickness. Empirical equations relating tire inflation pressure, normal load, tire diameter, and water film thickness are generated for various tire tread and surface configurations.

by G. A. Wray; I. R. Ehrlich

Stevens Inst. Of Tech., Hoboken, N. J. Davidson Lab.

Contract NAS-1-9349

Rept. No. SIT-DL-72-1602; NASA-CR-132 346 ; 1973 ; 80p 12refs

Prepared for National Aeronautics and Space Administration.

Availability: Corporate author

HS-014 401

### PERFORMANCE STANDARDS AND SPECIFICATIONS FOR AUTOMOTIVE BRAKES. FINAL REPORT

Efforts to develop a laboratory test procedure for measuring the performance of a brake assembly and individual components of a brake dynamometer are discussed. A test procedure is presented that measures brake retarding torque vs temperature, brake retarding torque vs speed, brake lining wear rate, and moisture sensitivity.

by J. J. Mikaila

Army Tank-Automotive Command, Warren, Mich.

Rept. No. TR-11741; AD-771 127 ; 1973 ; 48p 14 refs

Availability: NTIS

HS-014 402

### STAFF ANALYSIS OF BICYCLE ACCIDENTS AND INJURIES

The prevalence of bicycle accidents is noted from reviews of accident reports and special technical and research studies. The data indicate injury severity, emergency room treatment, locations of injuries, and the hazards of bicycle hardware. Further analysis is presented pertaining to loss of control, riding habits, and the role of the rider.

Public Health Service, Bethesda, Md.  
Rept. No. PB-207 665 ; 1972 ; 21p  
Availability: NTIS

HS-014 403

### **A STUDY OF ACCIDENT INVESTIGATION SITES ON THE GULF FREEWAY. INTERIM REPORT**

The degree of freeway congestion and delay caused by an accident depends upon the length of time that the accident vehicles block a lane and are visible to other freeway motorists. To reduce the effects of accidents, the investigation by policemen should be made at a location not visible to freeway motorists. The use of specially designed accident investigation sites which are located in areas adjacent to the Gulf Freeway in Houston but concealed from freeway motorists is discussed. Usage of the sites reduces delay to freeway motorists and frequency of secondary accidents.

by M. A. Pittman; R. C. Loutzenheiser  
Texas A and M Univ., College Station. Texas Transp. Inst.  
Rept. No. TTI-2-18-72-165-1; RR-165-1 ; 1972 ; 73p 6refs  
Prepared in cooperation with the Department of Transp.,  
Federal Hwy. Admin. Rept. for Sep 1971-Aug 1972.  
Availability: Corporate author

HS-014 404

### **HIGHWAY SAFETY, DESIGN AND OPERATIONS (THE NEED FOR A SAFER DRIVING ENVIRONMENT)**

A committee print of hearings on highway safety, design, and operations is presented. Roadside hazards are discussed in terms of widespread deficiencies, costs of poor design, urgent needs, and their history of neglect. The liability question of freeway signing and related geometrics is considered along with good signing practices and the need for interdisciplinary practices. Off-freeway traffic is also examined. Wet weather factors are described, such as the management of bad locations, individual responsibility, and the role of studded tires. State-to-state variations of traffic laws are noted and uniformity is advocated. Various operational deficiencies are also described. It is concluded that lives have been lost due to neglect.

Congress. House Public Works Com., Washington, D. C.  
Rept. No. HR-93-7 ; 1973 ; 53p  
93rd Congress, 1st Sess. Rept. of the Subcommittee on  
Investigations and Review.  
Availability: GPO

HS-014 405

### **REDUCTION IN FREEWAY CONGESTION BY USAGE OF ACCIDENT INVESTIGATION SITES**

Sixteen accident investigation sites designated along a 6-mile section of the Gulf Freeway in Houston are described. Eight are located on city streets adjacent to the freeway; two are on city streets under the freeway; and six are on unused space within the freeway right-of-way. During the first year of operation, 851 accidents were reported in the study area, and the sites were used for 339 investigations (40% usage). Another 176 investigations were conducted at other off-freeway locations. Benefits in terms of delay saved from usage

of the investigation sites and other off-freeway locations amount to \$203,000. The benefit-cost ratio was 28:1. Analysis showed that the sites under the freeway had a higher usage rate than those located on city streets.

by M. A. Pittman; R. C. Loutzenheiser  
Publ: Highway Research Record n469 p65-74 (1973)  
1973 ; 7refs  
Sponsored by Committee on Traf. Law Enforcement.  
Availability: See serial citation

HS-014 406

### **FATAL ACCIDENTS AND TRAVEL DENSITY**

State highway department reports summarizing fatal accident experience by the highway system and individual fatal accidents on the interstate system are examined in conjunction with interstate travel data. It is suggested that sections of a highway system with higher travel densities typically have lower fatal accident rates, and for equivalent travel density differences between sections of a highway system, differences in fatal accident rates tend to be greater at lower densities.

by B. V. Chatfield  
Publ: Highway Research Record n469 p40-51 (1973)  
1973 ; 5refs  
Sponsored by Committee on Freeway Operations.  
Availability: See serial citation

HS-014 407

### **EXPOSURE FACTORS IN ACCIDENTS AND VIOLATIONS OF YOUNG DRIVERS**

For a probability sample of 2800 drivers, a multivariate program, Multiple Classification Analysis, examined 12 exposure factors (amount and conditions of driving) in relation to number of accidents of any severity in the past year, and number of violations plus warnings. For young men and women the most important single factor was a composite mileage estimate, followed by percent of driving done after midnight vs. during daytime. For both groups, the several exposure factors together accounted for twice as much of the variance in violations (17% as in crashes (5% for young men, 9% for young women). Exposure accounted for more of the variance in accidents of older women (12%) than of older men (6%). Differences in marital status and residence are cited, and it is suggested that some of the exposure effects could be due to the kinds of people who choose to drive in certain highway environments, as well as to the inherent danger of these environments.



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y D. C. Pelz; S. H. Schuman  
Michigan Univ., Ann Arbor  
1971 ; 60p 19refs

sponsored by Michigan Univ., Ann Arbor, Highway Safety  
es. Inst. Using funds from the Automobile Manufacturers  
ssoc.

Availability: Donald C. Pelz, Inst. for Social Research, Univ.  
f Michigan

S-014 408

## **N APPROACH TO STATISTICAL ANALYSIS OF COUNTY TRAFFIC ACCIDENT DATA**

A mathematical model is presented for analyzing accident  
rates from county to county in California. Stepwise multiple  
linear regression techniques were used to discover how injury  
and fatal accidents on county roads are related to three varia-  
bles: unincorporated population (number of vehicles), miles of  
county roadway (number of possible accident-prone sites),  
and unincorporated population per mile of county roadway  
(traffic density). The model shows that injury and fatal ac-  
cidents in unincorporated areas per county per year are related  
to unincorporated population of county, resident accident rate,  
and zero population intercept.

y P. M. Hall  
California Univ. Inst. of Transp. and Traf. Engineering  
Rept. No. ITTE-RR-53 ; 1971 ; 13p 4refs  
Prepared as a part of the project, "Identification and  
Surveillance of High-Accident Locations," conducted under  
the Calif. Traf. Safety Prog. by the County Hwy. Safety  
Organization. Supported by the State of Calif. and the  
National Hwy. Safety Bureau.  
Availability: Corporate author

S-014 410

## **STUDY OF SNOWMOBILE DRIVE SYSTEMS**

Torque and speed controlled variable ratio V-belt transmission  
studies of snowmobiles were performed by analytical and ex-  
perimental methods. The usefulness and limitations of the  
results obtained by analytical methods are discussed. Mathe-  
matical derivations and graphical data on clutch system, belt  
drive force, and oscillation are given, along with engineering  
drawings. Findings related to acceleration and steady down  
shifting are noted.

y K. K. Prasad  
Arctic Enterprises, Inc., Thief River Falls, Minn.  
Rept. No. SAE-730782 ; 1973 ; 9p 4refs  
Presented at the National Combined Farm, Construction and  
Industrial Machinery and Fuels and Lubricants Meetings,  
Milwaukee, 10-13 Sep 73.  
Availability: SAE

S-014 412

## **UTOS, ENERGY, AND POLLUTION**

Problems related to automobile usage in urban environments,  
energy conservation, and air pollution are discussed. The lack  
of alternatives to driving personal vehicles is stressed.  
Problems of regulation are cited, and the attitude that nothing  
can be done to eliminate pollution is examined. Further con-

by M. Edel

Publ: Environment v15 n8 p10-7 (Oct 1973)

1973 ; 11refs

Pt. 1 of a two-part series which forms chap. 6 of Economics  
and the Environment Prentice-Hall, Inc., 1973.

Availability: See serial citation

HS-014 419

## **ON THE OPERATION OF AUTOMATED GROUND TRANSPORTATION SYSTEMS, PT. 1: URBAN PROBLEMS AND PERSPECTIVES**

Several approaches to the operation of automated ground  
transport systems for urban use are presented and evaluated.  
The problems of urban transportation and their origins are  
discussed, with the institutional structure, urban geography,  
and design of facilities for urban automotive transport  
identified as the principal elements. The origins of a significant  
portion of the urban transportation problem are found to lie  
outside the transport sector. Six potential applications for au-  
tomated transport systems are suggested, ranging from special-  
ized singlelink horizontal elevators to general purpose wide-  
area networks.

by M. B. Godfrey

Grant URT-9

Publ: IEEE Transactions On Vehicular Technology vVT-22 n1  
p1-6 (Feb 1973)

1973 ; 24refs

Sponsored by the Urban Mass Transp. Administration, Dept.  
of Transp. The first in a series of three papers in which urban  
transportation difficulties are reviewed.

Availability: See serial citation

HS-014 420

## **CHANGEABLE-MESSAGE SIGNS IN OHIO**

A proposed experimental freeway surveillance and traffic con-  
trol system in Cincinnati is discussed. Existing traffic and  
operational conditions are described, including the effect of  
the 55,000-seat capacity Sports Stadium. The need for the  
freeway surveillance and control system is based on an analy-  
sis of the cumulative effects on freeway operation of normal  
daily peak-hour and peak-period volumes occurring just prior  
to and following major stadium events. The system will utilize  
a series of changeable-message, matrix sign units located  
strategically on the freeway system approaching the downtown  
area. It will notify motorists of any adverse freeway condi-  
tions, give exit numbers for stadium parking, alternate traffic  
diversion routes, lane closures, and commuter parking div-  
ersion routes. Television cameras provide visual aid along with  
loop detectors. A control center is within the Sports Stadium.

HS-014 422

by E. N. Burns  
Publ: Highway Research Board Special Report n129 p7-12  
(1972)  
1972  
Availability: See serial citation

HS-014 422

### **SAFETY, SMALL CARS AND THE GASOLINE SHORTAGE**

The nature and size of the injury penalty associated with late model smaller cars in a crash are compared with those in late model standard sized cars. A severity index is used to compare injuries. It is shown that, overall, the injury severity for belted drivers in subcompacts is almost identical to that of unbelted drivers of standard sized cars. Sub-compact car drivers have more than 11/2 as many serious injuries as standard car drivers under similar crash circumstances.

by B. J. Campbell  
North Carolina Univ., Chapel Hill Hwy. Safety Res. Center  
1973 ; 5p  
Availability: Corporate author

HS-014 423

### **INVESTIGATION OF NEW TRAFFIC SIGNS, MARKINGS AND SIGNALS. VOL. 1. LABORATORY EXPERIMENTS AND ROAD TESTS**

Recommended new traffic signs, markings, and signals are evaluated, based on recognizability and population stereotypes. Twenty newly proposed, experimental signs were laboratory-tested each pictographic sign with no legend. It was found that with education, visual response was greater with the pictographs than with standard signs. In simulated driving situations, the experimental signs without legends were more easily recognized by the average drivers than the standard signs, for five of the seven signs tested. Questionnaires were also used to determine population stereotypes, probing the signal's meaning, its implication for action, and consumer acceptability of type of device. It was shown that people prefer signs with both symbols and letters, and they recognize the need for standardization in traffic control devices.

by C. W. Dietrich; J. Markowitz  
Bolt Beranek and Newman, Inc., Cambridge, Mass.  
Contract FH-11-6929; FH-11-7960  
Rept. No. BBN-1762 ; 1972 ; 85p 5refs  
Prepared for Federal Hwy. Administration, Department of Transp.  
Availability: Corporate author

HS-014 424

### **INVESTIGATION OF NEW TRAFFIC SIGNS, MARKINGS AND SIGNALS. VOL. 2. DRIVER QUESTIONNAIRE**

Questionnaire responses to a study of traffic control devices are presented and evaluated. Three areas were assessed: the meaning of the device as a symbol, its implication for driver action, and driver preferences (consumer acceptability) for one

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by G. Jones  
Bolt Beranek and Newman, Inc., Cambridge, Mass.  
Contract DOT-FH-11-7960  
Rept. No. BBN-1762 ; 1972 ; 207p  
Prepared for Federal Hwy. Administration, Department of Transp.  
Availability: Corporate author

HS-014 425

### **HOW TO LIVE WITH EMISSION CONTROLS**

Auto pollution comes from four different areas: crankcase, gas tank, carburetor and exhaust pipe. Understanding these systems and how they work is the first step toward living with them and keeping them functioning properly. While antismog devices are assumed to increase fuel consumption, catalytic convertors promise to reverse the gas-consumption tendencies. Most 1975 cars will be equipped with convertors which will permit them to meet government standards calling for a 97% reduction in hydrocarbons and a 96% reduction of 13% in fuel consumption. Automobile manufacturers are now concerned with controlled combustion systems which involve positive crankcase ventilation (PVC); redesign of fuel tanks to prevent spillage; new camshafts to increase valve overlap; intake manifolds designed to provide more rapid fuel vaporization during engine warmup; modification of piston-head design to reduce compression ratios; thermostatically controlled air cleaners and air injection systems.

by M. Schultz  
Publ: Popular Mechanics v141 n4 p128-32 (Apr 1974)  
1974  
Availability: See serial citation

HS-014 426

### **USING FINITE ELEMENTS IN AUTOMOTIVE DESIGN**

The use and power of finite element methods in automotive design is explained, with illustrations given of the kinds of automotive structures where they can be used. The finite element methods allow the engineer to solve problems with complicated geometry. The mathematics involved are derived with variable dimensional sizes to provide maximum flexibility in approximating complicated shapes. Typical applications include bumpers, frames, fan centrifugal stresses, suspension control arms, mufflers, forgings, castings, sandwich structures, and body structures.

Publ: Automotive Engineering v82 n4 p25-31 (Apr 1974)  
1974  
Availability: See serial citation

HS-014 427

### **SOLID-STATE DEVICES FOR AUTOMOTIVE ELECTRONICS**

The operating principles, applications, and functions of two basic, active solid-state devices, bipolar and field-effect transistors, are explained. Both types use a voltage applied to a gate electrode or region to control one type of carrier charge

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Publ: Automotive Engineering v82 n4 p32-6 (Apr 1974)

1974

Based on SAE-740010 (part of SP-388) "Discrete Solid-State Devices", by J. A. Olmstead. Presented at the SAE

Automotive Engineering Congress, 25 Feb - 1 Mar 1974, Detroit.

Availability: See serial citation

HS-800 861

## **SURVEY OF SUSPENSION SYSTEMS ON MOTOR HOMES. VOL. 8. FINAL REPORT**

A survey of 214 motor homes was made to determine in-use vehicle loads and to compare them with suspension system capacities. Vehicles were surveyed as they arrived at national parks in their operating condition. Tasks performed were: measurement of individual wheel loads; identification measurements of suspension components; recording of manufacturer's label data; assessment of owner's knowledge of vehicle load capacities; determination of suspension component capacities from data furnished by manufacturers and Tire and Rim Assoc.; comparison of actual weights with furnished data; and review of load capacity data available to owners. Results showed: loads of surveyed units exceeded capacities in 54% of the front and 27% of the rear suspension systems; 16-25% of all units (depending on options) had greater front end delivered weight than system capacity; tires were the weakest component in 38% of the front and 54% of the rear suspension systems; 43% of the units had a combined weakest front and rear system rating and 39% had suspension system capacities below the manufacturer's gross vehicle weight rating (GVWR); GVWR information on the manufacturer's plate was inadequate; owner's manuals did not include enough instruction on weight considerations; owner's manuals contain information on correct tire inflation pressure but 65% of all surveyed motor home tires were inflated under maximum recommended tire pressures.

by N. Ludtke

Pioneer Engineering and Mfg. Co., Inc., Warren Mich.

Contract DOT-HS-098-1-136

1973 ; 260p

Rept. for May 1971-Mar 1972. Vols. 1-6 (on truck-mounted ampers) of this survey are HS-800 843, HS-800 839, HS-800 838, HS-800 852, HS-800 862, and HS-800 880 respectively.

Vol. 10 (on camper trailers) is HS-801 001.

Availability: NTIS

HS-801 062

## **IMPROVING HIGHWAY SAFETY MANPOWER: TRAFFIC ENGINEERING TECHNICIAN PROJECT AT LONGVIEW COMMUNITY COLLEGE AND COMMUNITY COLLEGE OF DENVER. FINAL REPORT, PHASE II**

An associate degree curriculum to develop traffic engineering technicians was tested. Materials on traffic accident investigation were introduced into the curriculum to determine their appropriateness in preparing the technicians. It was found that the curriculum tested was adequate. Instructional materials were integrated effectively. It was recommended that the experiences of the participating colleges should be utilized as a

lices to the report contain an instructor's guide reflecting the experience of the participating colleges and the suggestions of the instructors who participated in the project.

by A. S. Karim

American Assoc. of Community and Junior Colleges,

Washington, D. C.

Contract FH-11-7495

1973 ; 116p 14refs

Rept. for 6 May 1971-31 Aug 1973.

Availability: NTIS

HS-801 067

## **FEASIBILITY OF HIGH-RESOLUTION PULSE-ECHO TECHNIQUES FOR AUTOMOBILE TIRE INSPECTION. INTERIM REPORT**

Results of bench-top experiments designed to assess the potential of ultrasonic reflection (pulse-echo) techniques for nondestructive tire testing are presented. High-resolution reflection techniques are described along with reflections at interfaces, reflection signals from representative tire structures, and scan-generated displays. The data show that modern pulse echo ultrasonic techniques employing short pulses from highly damped transducers, with fundamental frequencies in the range of 1- to 5-MHz, are capable of definitively characterizing the laminar structure of such samples, and will reveal the presence and nature of defects ranging from gross separations to subtle variations in interface bonding.

by R. P. Ryan

Department of Transp., Cambridge, Mass., Transp. Systems Center

Rept. No. DOT-TSC-NHTSA-72-11 ; 1973 ; 76p 14refs

Availability: NTIS

HS-014 409

## **DEVELOPMENT AND OPERATION OF OECD TRACTOR TEST CODE**

The tractor test code developed by the Agricultural Directorate of the Organization for Economic Cooperation and Development is discussed and compared with other test codes in several countries. It is specifically compared with the Nebraska test codes for tractors. Procedures and requirements are detailed, including retesting, specifications, drawbars, hydraulics, brake performance, and noise. It is concluded that a common test code should be developed and accepted to end the difficulties that arise, especially concerning power ratings, with the present multiplicity of test codes.

HS-014 411

by T. C. D. Manby; J. Matthews  
National Inst. of Agricultural Engineering, Silsoe, Beds.  
(England)  
Rept. No. SAE-730762 ; 1973 ; 14p 11refs  
Presented at the National Combined Farm, Construction and  
Industrial Machinery and Fuels and Lubricants Meetings,  
Milwaukee, 10-13 Sep 73.  
Availability: SAE

HS-014 411

### **AUTOS FEED ON OIL: AND WE BREATHE THE RESULTS**

Automobile usage as a source of air pollution is discussed with focus on the political power of economic interests such as the oil companies, road builders, truckers, and other manufacturing groups. The basis of their power is explored, including the view that the problem is due to monopoly in the petroleum industry. Environmental problems caused by national and international competition are described. The political power of the petroleum companies is cited along with obstacles to countervailing the power.

by M. Edel  
Publ: Environment v15 n9 p34-7 (Nov 1973)  
1973 ; 4p 5refs  
Pt. 2 of a two-part series which forms chap. 6 of Economics and the Environment, Prentice-Hall, Inc., 1973.  
Availability: See serial citation

HS-014 413

### **AN OPTIMAL AUTOMATIC CAR-FOLLOWING SYSTEM**

An automatic car-following system based on optimal control theory is developed for a variety of cost functions and the resultant system is simulated on an analog computer. Position and velocity response as well as local and asymptotic stability characteristics of a line of several vehicles are examined. Line behavior when a vehicle leaves or enters the line is also considered. By proper choice of the cost function, it is shown that a car-following system can be obtained which meets the outlined objectives. Various forms of cost functionals are investigated in order to determine their effect on system performance.

by L. E. Peppard; V. Gourishankar  
Publ: IEEE Transactions on Vehicular Technology vVT-21 n2 p67-73 (May 1972)  
1972 ; 13refs  
Sponsored by the National Res. Council of Canada.  
Availability: See serial citation

HS-014 414

### **NORMAL AND EMERGENCY CONTROL OF A STRING OF VEHICLES BY FIXED REFERENCE SAMPLED-DATA CONTROL**

A fixed reference control scheme for automated highways is proposed. Each vehicle controls itself, avoiding multiloop feedback. A simple proportional-integral-derivative (PID) con-

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was examined. The post system proved to work well. For emergency stopping, a PI controller using a tachometer on a braked wheel can bring a vehicle with rubber tires to a controlled skid-free stop. From the simulation, the effect of using sampled command velocity rather than continuous command velocity has become clear. One was longer stopping distance, and another was oscillation in the wheel's angular velocity. From these, it seems advisable that posts should send deceleration rate information as well as command velocity. Alternatively, vehicles should have an estimator for deceleration rate.

by D. E. Whitney; M. Tomizuka  
Contract DOT-C-85-65  
Publ: IEEE Transactions on Vehicular Technology vVT-21 n4 p128-38 (Nov 1972)  
1972 ; 11refs  
Presented at the 22nd IEEE Vehicular Technology Conference, Detroit, 7-8 Dec 71, and at the National Conference on Personal Rapid Transit, Minnesota Univ., 1971.  
Availability: See serial citation

HS-014 415

### **A MICROWAVE ANTICIPATORY CRASH SENSOR FOR ACTIVATION OF AUTOMOBILE PASSIVE RESTRAINTS**

For effective protection of automobile occupants in high-speed collisions, passive restraints such as air bags must be actuated prior to impact. A 10-GHz CW homodyne bistatic radar system has been developed to permit exploration of the feasibility of such an application. System design and response to potential real and false-alarm targets and to the automotive environment are delineated. Possible elaborations on the basic system are described.

by F. R. Holmstrom; J. B. Hopkins; A. T. Newfell; E. F. White  
Publ: IEEE Transactions on Vehicular Technology vVT-22 n2 p46-54 (May 1973)  
1973 ; 7refs  
Sponsored by the Office of Vehicle Structures Res. and the National Hwy. Traf. Safety Admin. Presented at the IEEE Vehicular Technology Conference, Detroit, 7-8 Dec 1971.  
Availability: See serial citation

HS-014 416

### **AUTOMATIC ROUTE CONTROL SYSTEM**

The Automatic Route Control System (ARCS) is a self-contained on-board system that directs the operation of a conventional motor vehicle over predetermined routes and controls activities (such as delivery or pickup of items) performed along the route. It continuously measures the vehicle's location coordinates, compares them with the route coordinates, and issues audio, visual, and/or printed instruction. It also detects driver errors and prescribes corrective action. The routes to be followed and the actions to be taken are defined on interchangeable magnetic tape cartridges, which may be updated daily. ARCS enables a driver to operate efficiently over a complex route without reference to maps or lists and without prior knowledge of the route, and it eliminates tedious manual report preparation due to the computer-ready data.

by R. L. French; G. M. Lang  
 Publ: IEEE Transactions on Vehicular Technology vVT-22 n2  
 36-41 (May 1973)  
 1973 ; 6refs  
 Presented at the IEEE Vehicular Technology Conference,  
 Detroit, 7-8 Dec 1971.  
 Availability: See serial citation

S-014 417

## ELECTRICAL SYSTEMS FOR HYBRID VEHICLES

Electrical systems for hybrid vehicles as a means of reducing  
 exhaust emissions from street-operated vehicles are described.  
 The electrical system is composed of an electric traction  
 motor, a generator, control system, and batteries. The electri-  
 cal system parameters or characteristics that have the greatest  
 impact on the total system are considered. Details of the ad-  
 vantages and disadvantages of various approaches are sum-  
 marized, and development efforts are recommended.

by R. C. LaFrance; R. W. Schult  
 Contract F04701-70-C-0059  
 Publ: IEEE Transactions on Vehicular Technology vVT-22 n1  
 3-9 (Feb 1973)  
 1973 ; 8refs  
 Presented at the IEEE Vehicular Technology Conference,  
 Detroit, 7-8 Dec 71.  
 Availability: See serial citation

S-014 418

## CONTROL ASPECTS OF A DUAL-MODE TRANSPORTATION SYSTEM

The control problems associated with the operation of a net-  
 work of automatically controlled, closely spaced high-speed  
 vehicles are considered. A system operating concept based on  
 the synchronous moving-cell approach to individual vehicle  
 control is presented. The need for a network traffic-manage-  
 ment strategy is pointed out and one such strategy called cycle  
 reprogramming, is discussed and its efficiency described.

by R. G. Stefanek; D. F. Wilkie  
 Publ: IEEE Transactions on Vehicular Technology vVT-22 n1  
 7-13 (Feb 1973)  
 1973 ; 13refs  
 Availability: See serial citation

S-014 428

## HOW EGR AFFECTS ENGINE PERFORMANCE

An engineering analysis is presented for obtaining optimum  
 results from exhaust gas recirculation (EGR) in vehicle drivea-  
 bility and fuel consumption. Engine and vehicle parameter stu-  
 dies of current V-8 engines with EGR show that: optimum  
 spark timing increasing EGR rate up to the driveability limit  
 results in a reduction in oxides of nitrogen emissions without a  
 loss in fuel economy; increasing EGR rates with minimum for  
 best torque (MBT) spark timing can result in deterioration in  
 hydrocarbons (HC) control; to optimize oxides of nitrogen  
 emission reduction, EGR rate should be increased to the  
 driveability limit, spark timing should be adjusted toward  
 MBT, and air/fuel ratio should be adjusted to 14:1. With ac-  
 ceptable driveability, maximum EGR rate appears to increase

Publ: Automotive Engineering v82 n4 p43-9 (Apr 1974)  
 1974

Based on SAE-740104, "Optimizing Engine Parameters with  
 Exhaust Gas Recirculation," by J. J. Gumbleton, R. A.  
 Bolton, and H. W. Lang. Presented at the Automotive  
 Engineering Congress and Exposition, Detroit, 25 Feb - 1  
 Mar 1974.

Availability: See serial citation

HS-014 429

## RELATIONSHIP BETWEEN THE STEADY- HANDLING CHARACTERISTICS OF AUTOMOBILES AND THEIR STABILITY

Analyses of the steady-state handling behavior of an automo-  
 bile and the stability of its steady-turning motion, based on a  
 three-degree of freedom mathematical model, are used to  
 show that the steady behavior and the stability are related  
 similarly in the nonlinear region as in the well-documented  
 linear one. It is concluded that analysis and measurement of  
 the steady behavior will yield information on the stability of  
 automobiles.

by R. S. Sharp  
 Publ: Journal of Mechanical Engineering Science v15 n5 p326-  
 8 (Oct 1973)  
 1973 ; 3refs  
 Availability: See serial citation

HS-014 430

## EXPERIMENTAL INVESTIGATION OF THE PARAMETERS AFFECTING THE CASTOR STABILITY OF ROAD WHEELS

The experimental testing of a model castoring wheel on a mov-  
 ing road surface is described. The stability of this steerable  
 wheel was investigated as a function of various geometrical  
 and physical parameters. A most important parameter was  
 found to be the lateral stiffness of the system relative to the  
 steering axis. Previous work has explained instability in terms  
 of tire behavior, but in these tests a tireless wheel was used to  
 find a more fundamental cause. It was concluded that the  
 overall lateral stiffness of the wheel system, of which tire  
 stiffness is one component, is important. The graphical results  
 form a basis for improving the design of motorcycle and au-  
 tomobile front wheel assemblies.

by G. E. Roe; T. E. Thorpe  
 Publ: Journal of Mechanical Engineering Science v15 n5 p365-  
 9 (Oct 1973)  
 1973 ; 5refs  
 Availability: See serial citation

HS-014 431

## THEORY OF CASTOR OSCILLATIONS

The oscillation of castored wheels is discussed and a theory  
 presented which is applicable to motorcycle stability, and  
 which covers tire deformation as a special case. The  
 mechanism is described with an energy diagram. It is con-  
 cluded that the instability of a simple vertical axis caster  
 seems due to an ability for the contact patch to move laterally  
 relative to the steering axis. The stiffness of the

HS-014 432

by G. E. Roe  
Publ: Journal of Mechanical Engineering Science v15 n5 p379-81 (Oct 1973)  
1973 ; 4refs  
Availability: See serial citation

HS-014 432

### **STUDY OF FLOAT SYSTEM OF CARBURETOR**

Dimension of a float chamber must be generally determined, considering the rise of fuel level in the float chamber under the external vibrations corresponding in idle conditions, low speed runnings and on rough roads, an optimum response of fuel level to transient fuel flow resulting in accelerated or decelerated operations of engine. The natural frequency of a float in finite dimension chamber was theoretically calculated and compared with experimental results, using the model for an ordinary float chamber. Rise of the fuel level with resonance of its system due to the periodic forced vibrations is explained. Various modes of wave and their influence upon the rise of fuel level due to those waves were determined and the initial response of the fuel level in the float chamber to step discharge flow from its chamber is examined, changing area ratios of float to float chamber. These experimental results are compared with theoretical results calculated from the transfer function of float system. Limited values of these ratios were found, considering the optimum response of the fuel level to the transient fuel discharge, frequency response of the fuel level to the periodic fuel discharge flow, and the rise of fuel level under vibrations.

by J. Uozumi; S. Takada  
Publ: SAE of Japan Bulletin n4 p1-17 (1972)  
1972 ; 7refs  
Availability: Japan SAE. Tokyo, Japan

HS-014 433

### **RADIANT HEAT TRANSFER IN A DIESEL ENGINE CYLINDER**

The heat flux at each crank angle flowed from gases to the cylinder wall was measured experimentally in a diesel engine to determine radiant heat transfer. The radiant heat flux was extracted from the total heat flux by a thermocouple covered with a sapphire window. Integrating the instantaneous values of both radiant and total heat fluxes, the ratio of the former flux to the latter was determined versus the value of indicated mean effective pressure, and the importance of the radiant heat transfer was confirmed.

by T. Oguri; S. Inaba; H.-J. Hsiue  
Publ: SAE of Japan Bulletin n4 p18-28 (1972)  
1972 ; 6refs  
Supported by Japan Automobile Research Institute, Inc.  
Availability: Japan SAE. Tokyo, Japan

HS-014 434

### **A STUDY OF VALVE TRAIN NOISES**

Valve train noises at a low engine speed include noises which are caused at the instant when the valve opens and at the in-

HSL 74-9

speed. The latter noises are caused by friction vibration due to the metal to metal contact, the occurrence of which has close relationships with the thickness of oil film between the cam and follower and their surface roughness. Test results show that the sources of the latter noises are at the points where the oil film velocity becomes zero. Chatter marks and waviness on the contact surface of the cam make the latter noises bigger. Valve train noises at the high engine speed are caused by irregular valve behaviors.

by M. Hanaoka; S. Fukumura  
Publ: SAE of Japan Bulletin n4 p29-38 (1972)  
1972 ; 4refs  
Availability: Japan SAE. Tokyo, Japan

HS-014 435

### **EVALUATION AND GENERATING METHODS OF INDUCTION SWIRL IN DIRECT INJECTION DIESEL ENGINE**

Swirl strength, one of the factors influencing the combustion of a direct injection diesel engine, is evaluated with the ratios of circumferential and axial air velocities to the square root of the pressure drop across the valve seat measured on a steady flow test bench. Shrouded valve creates swirl strength up to 400% according to the angle and location of the shroud. Directional port can be designed due to the linear-function between the calculated air velocity of the minimum sectional area of the upper part of the valve seat and the ratio between the circumferential air velocity and the square root of the pressure drop.

by A. Kobayashi  
Publ: SAE of Japan Bulletin n4 p39-48 (1972)  
1972 ; 4refs  
Availability: Japan SAE. Tokyo, Japan

HS-014 436

### **INFLUENCE OF ENGINE DESIGN FACTORS ON EXHAUST EMISSIONS FROM AUTOMOTIVE GASOLINE ENGINE**

Experiment and analysis employing a single cylinder engine were carried out to research the effects on exhaust emissions of variation in major engine design factors - stroke volume, stroke bore ratio and compression ratio. These engine design factors determine the combustion chamber surface area to volume ratio (S/V ratio) and it is clarified that in proportion to the S/V ratio, hydrocarbon (HC) concentration increases and oxides of nitrogen concentration tends to decrease. The authors suggest the directions in engine design factors for the control of exhaust emissions.

by Y. Sakai; N. Tokura; S. Tsutsumi; K. Mukai  
 Publ: SAE of Japan Bulletin n4 p49-57 (1972)  
 1972 ; 3refs  
 Availability: Japan SAE. Tokyo, Japan

HS-014 437

# **PRACTICAL ANALYSIS OF EFFECT OF EXHAUST GAS RECIRCULATION ON NO<sub>x</sub> EMISSION CONTROL**

It is hypothesized and confirmed that oxides of nitrogen formation is primarily affected by the heat capacity of the combustion gases and recycled exhaust gas. The hypothesis was tested in an experimental program involving admission of inert gases and water in place of ex-haust gas recirculation (EGR). It is shown that engine output and efficiency are significantly affected by the heat capacity of the combustion gases. It is concluded that EGR functions by increasing the heat capacity of the working fluid, and that the correlative changes in oxides of nitrogen and engine performance can be predicted from these heat capacity considerations.

by S. Ohigashi; H. Kuroda; Y. Nakajima; Y. Hayashi; K. Sugihara  
 Publ: SAE of Japan Bulletin n4 p58-65 (1972)  
 1972 ; 6refs  
 Availability: Japan SAE. Tokyo, Japan

HS-014 438

# **OXIDES OF NITROGEN FROM ACCELERATING GASOLINE ENGINE**

Oxides of nitrogen from the accelerating gasoline engine were measured on the engine test bench by simulating the vehicle acceleration on the road. Influences of engine variables on oxides of nitrogen emissions in acceleration as well as in the cruise condition are qualitatively studied, and a method for estimating the NO concentration in acceleration from cruising exhaust emissions is shown. NO in acceleration increases in the latter half of acceleration due to the leaner mixture.

by T. Saito; T. Takahashi  
 Publ: SAE of Japan Bulletin n4 p66-74 (1972)  
 1972 ; 3refs  
 Availability: Japan SAE. Tokyo, Japan

HS-014 439

# **TRANSIENT CHARACTERISTICS OF AUTOMATIC TRANSMISSION DURING GEAR RATIO CHANGE**

In theoretical analysis of the output torque disturbances which appear during gear ratio change of the automatic transmission, it is proven that the strict theoretical results, which are obtained in consideration of the flow through an orifice and the output speed as well as engine and torque converter characteristics, show good agreement with experimental results. It is shown that the torque disturbances can be reduced by incorporating an appropriate accumulator and orifices in the hydraulic control circuit. The output torque disturbances can be estimated at the stage of design.

by S. Ito; K. Suzuki  
 Publ: SAE of Japan Bulletin n4 p75-82 (1972)  
 1972 ; 2refs  
 Availability: Japan SAE. Tokyo, Japan

HS-014 440

# **SHAKING PHENOMENA OF TRUCKS AND THEIR ANALYSES**

The shaking phenomena that determine the ride comfort of a truck running at high speed is examined experimentally and theoretically. The frame and rear body are theoretically assumed to be variable section beams and to be excited by forces transferred from many vibration systems. A brief survey of the effect of tuning the engine suspension system is also presented.

by B. Hagiwara  
 Publ: SAE of Japan Bulletin n4 p83-90 (1972)  
 1972 ; 3refs  
 Availability: Japan SAE. Tokyo, Japan

HS-014 441

# **ON HARSHNESS AFFECTING VEHICLE RIDING COMFORT**

It is often experienced that the riding comfort of a vehicle running on the paved road is markedly affected with the road joint harshness. This vibration and sound influencing harshness are analyzed and evaluated by the paired comparison method and linear regression analysis. By using the formula given, it is justified that the harshness is approximately determined with both characteristics of tire and suspension fore-and-aft compliance. The test equipment installed to examine the effects of suspension components and some experimental results are described.

by T. Tokuda; M. Hiruma; K. Fukiage  
 Publ: SAE of Japan Bulletin n4 p91-100 (1972)  
 1972 ; 14refs  
 Availability: Japan SAE. Tokyo, Japan

HS-014 442

# **TORSIONAL SHOCK VIBRATION CAUSED BY THE IMPACTS OF GEARS AND SPLINES**

Torsional shock vibration caused by the impact of gears and splines, which will induce annoying shock noise is examined. Experiments and analog simulation were conducted, and it was found that the less the clearance of transmission gears, the less the shock vibration. Changing the torsion rigidity of each part also decreases shock vibration.

by S. Miyamoto; H. Oishi  
Publ: SAE of Japan Bulletin n4 p101-5 (1972)  
1972 ; 3refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 443

## **THE RESPONSE OF MAN-CAR SYSTEM AGAINST DISTURBANCE**

The response of a man-car system against disturbance was examined in a simple running test following a sinusoidal course. According to the contrast of this experiment with the analog simulation results of a man-car system, the human characteristics could be determined. Responses of the man-car system are analyzed against wind gust disturbance by means of those characteristics.

by S. Chikamori; T. Etoh  
Publ: SAE of Japan Bulletin n4 p106-13 (1972)  
1972 ; 5refs  
Also pub. in Transactions of the Society of Automotive Engineers of Japan n1 1970.  
Availability: Japan SAE, Tokyo, Japan

HS-014 444

## **AN ANALYSIS OF POWER HOP PHENOMENON**

The power hop vibration phenomenon is analyzed as a non-linear equation which is solved with the aid of a digital computer using the Runge-Kutta-Gill method. Two nonlinear elements in drive-line and rear suspension systems are considered: clutch torque characteristics and tire spring characteristics. The power hop coefficients are introduced to simulate power hop phenomenon, and the theory is substantiated by experiments with test vehicles. The power hop coefficients of several rear suspension systems are presented to facilitate the design.

by K. Chiku; S. Okawa; F. Takenaka  
Publ: SAE of Japan Bulletin n4 p114-26 (1972)  
1972 ; 3refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 445

## **EFFECTS OF VIBRATIONAL FACTORS ON BENDING FATIGUE STRENGTH OF TRUCK FRAMES**

Bending stresses occurring on truck frames when the trucks run on rough roads were analyzed and some effects of various factors were investigated. It is noted that in design, it is necessary to give adequate consideration to the following areas: the relation between the node positions of the first bending mode and the positions of mounting suspension systems, resonance frequencies of various vibration modes, and reduction of forces transmitted from the suspension systems. Comparison and evaluation of fatigue strength were simplified by expressing the magnitude of random stress with equivalent stress.

by S. Mochizuki; N. Yasuda  
Publ: SAE of Japan Bulletin n4 p127-34 (1972)  
1972 ; 5refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 446

## **DYNAMIC CHARACTERISTICS OF AIR BAG**

The energy absorbing characteristics of an air bag are analyzed in the form of a simple mathematical model and are compared with results determined in a bench test using a body block. Using the model, the effects of the air bag volume were examined, along with outlet diameter, types of gas outlets, and time coordination between the bag inflation and the secondary impact on the shock-absorbing characteristics.

by H. Furusho; K. Yokoya; O. Fujii  
Publ: SAE of Japan Bulletin n4 p135-44 (1972)  
1972 ; 4refs  
Also pub. in Transactions of the Society of Automotive Engineers of Japan n2 (19-72).  
Availability: Japan SAE, Tokyo, Japan

HS-014 447

## **ANALYSIS OF OCCUPANT'S MOVEMENTS IN HEAD-ON COLLISION. PT. 2. IN THE CASE OF OBLIQUE COLLISION**

Assuming a three-dimensional model (with 12 degrees of freedom), occupant movements in oblique collision were simulated by numerical calculations. Comparing results of mathematical simulation with the experimental data, a fairly good agreement was obtained. It was found that the occupant in oblique collision makes a translational motion in the impact direction without change of posture and there is no essential difference between occupant movements in oblique collision and in frontal collision. The left seat belt load differs from the right and the twisting and bending movement takes place at torso and pelvis according to the increase of impact angle and anchorage width. These are not so great as to injure the occupant seriously. It is estimated that it is possible to deal with oblique collision in approximately the same fashion as frontal collision if the vehicle impact angle is small.

by H. Furusho; K. Yokoya  
Publ: SAE of Japan Bulletin n4 p145-55 (1972)  
1972 ; 6refs  
Also pub. in Transactions of the Society of Automotive Engineers of Japan n1 (1970)  
Availability: Japan SAE, Tokyo, Japan

HS-014 448

## **SIMULATION OF OCCUPANT MOVEMENTS EQUIPPED WITH AIR BAG**

Assuming a mathematical model of an occupant equipped with an air bag, occupant movements in a frontal collision were simulated by the numerical calculations of equations of motion (seven degrees of freedom). The mathematical results are compared with experimental data, and a fairly good agreement was obtained. It is concluded that the mathematical model is valid for the practical purpose.



by H. Furusho; K. Yokoya; O. Fujii  
Publ: SAE of Japan Bulletin n4 p156-65 (1972)  
1972 ; 3refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 449

### **DIRECTION CHANGE PERFORMANCE OF AUTOMOBILE. UTILITY OF STEERING SYSTEM WITH DERIVATIVE TERM**

Direction change performance of an automobile is examined. The characteristics that help to avoid an obstacle are evaluated: minimum avoidable distance (L), and maximum amplitude of the path (W) after a car has changed its direction. L and W are measured for some passenger cars, and the influence of gear ratio and the derivative term of the steering system on L and W are investigated.

by O. Hirao; M. Abe  
Publ: SAE of Japan Bulletin n4 p166-72 (1972)  
1972  
Availability: Japan SAE, Tokyo, Japan

HS-014 450

### **ANALYSIS OF BEHAVIOR OF PEDESTRIAN IN COLLISION. MATHEMATICAL ANALYSIS**

The motion of a pedestrian is analyzed numerically with seven degrees of freedom by modeling a vehicle-to-man collision. According to comparison of the numerical computation with experimental data, nearly good results are shown. It is found that the modeling was a reasonable attempt and that this simulation could be used in the analysis of vehicle-to-man collision phenomena.

by K. Katayama; T. Shimada  
Publ: SAE of Japan Bulletin n4 p173-83 (1972)  
1972  
Availability: Japan SAE, Tokyo, Japan

HS-014 451

### **INFORMATION PROCESSING FOR AUTOMOBILE DRIVING**

In an examination of information processing for automobile driving, the defect of a previous compensation method is clarified in which course deviation is detected in front of the vehicle. Advance time compensation is proposed for the delay of information processing, including the reaction time of the driver in order to stabilize the course tracking.

by E. Kikuchi  
Publ: SAE of Japan Bulletin n4 p184-9 (1972)  
1972 ; 6refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 452

### **GAS MOVEMENT INSIDE COMBUSTION CHAMBER OF CRANKCASE COMPRESSION TWO-STROKE**

### **CYCLE ENGINE WITH SCHNURLE SCAVENGE TYPE**

Gas flow velocities inside the combustion chamber of a two-stroke cycle engine were measured successfully in the firing and motoring run. Test results suggest that the gas movement in a firing run differs from that in motoring during the scavenging process, but in the last stage of the compression stroke, the velocities in both conditions are similar. In two types of the combustion chambers, hemispherical and wedge, flow velocities, cycle-to-cycle fluctuations of velocities and directions of main flows were measured in motoring runs, and behaviours of air movements inside the combustion chamber were made clear.

by S. Ohigashi; Y. Hamamoto; S. Tanabe; T. N. de Saram  
Publ: SAE of Japan Bulletin n5 p1-10 (1973)  
1973 ; 8refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 453

### **INFLUENCE OF STROKE BORE RATIO AND COMPRESSION RATIO ON NO<sub>x</sub>**

Based on a previous study of the influence of engine design factors on exhaust emissions, some more experimental analyses are reported on oxides of nitrogen (NO<sub>x</sub>) mass emissions relative to the power output and fuel economy. The analyses showed that under the same power output and fuel consumption conditions, the long stroke tends to reduce NO mass emissions, and that high compression ratio does not always increase NO mass emissions.

by Y. Sakai; H. Miyazaki; S. Tsutsumi; K. Mukai; M. Saito  
Publ: SAE of Japan Bulletin n5 p11-8 (1973)  
1973 ; 1ref  
Availability: Japan SAE, Tokyo, Japan

HS-014 454

### **SIMULATION OF PROCESSES OF FUEL INJECTION**

A digital simulation of a diesel injection-system is developed in which an approximate lumped-parameter network for simulating the high-pressure line is adopted in order to attain a quick processing of the computation with a tolerable accuracy. Comparisons of the computer results with experimental ones show satisfactory accuracy and validity of the algorithm concerned. Further work is carried out to construct a more reasonable network of the high-pressure line.

by M. Ikegami; H. Horike; F. Nagao  
Publ: SAE of Japan Bulletin n5 p19-29 (1973)  
1973 ; 6refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 455

### **GASES IN PISTON TOP-LAND SPACE OF GASOLINE ENGINE**

The unburned gas compressed into a piston top-land space which influences hydrocarbon in the exhaust gas is cited, and thermodynamic calculations are attempted for the concentration of the mixture compressed into the piston top-land space. The gas in the space was sampled through an electromagnetic

HS-014 456

valve fixed on the piston. Inorganic gases and total hydrocarbon were analyzed. The gas behavior at the piston top-land space was revealed.

by S. Furuhashi; Y. Tateishi  
Publ: SAE of Japan Bulletin n5 p30-9 (1973)  
1973 ; 6refs  
Sponsored by the Japan Automobile Research Institute Inc. (JARI) and the Nissan Motor Co.  
Availability: Japan SAE, Tokyo, Japan

HS-014 456

### **A METHOD TO ESTIMATE DIESEL SMOKE AT HIGH ALTITUDE**

Exhaust smoke of diesel engines is increased at high altitude. A method to predict the increase at the altitude required to design a ventilation system of a tunnel is described. Engine bench tests which simulate intake air pressures at various altitudes and the vehicle tests at high-altitude roads were performed, and a remedial method was derived from the test results.

by T. Saito; H. Date  
Publ: SAE of Japan Bulletin n5 p40-9 (1973)  
1973 ; 4refs  
Prepared in cooperation with Fuel and Lubricants Committee of Japan Automobile Research Institute Inc. (JARI)  
Availability: Japan SAE, Tokyo, Japan

HS-014 457

### **A TORSIONAL STRENGTH ANALYSIS OF LADDER-TYPE TRUCK FRAMES PROVIDED WITH OPEN-SECTION MEMBERS**

A new method of torsional strength analysis for a truck frame with open-section members has been developed. The conventional analytical methods often generate values more than twice smaller or larger than the actual stress. A special strain meter is used in the new method for detailed measurement of the stress distribution, giving a clarification of the load transmission process. The calculated values offer satisfactory agreement with experimental values within a 10% range.

by K. Takahashi  
Publ: SAE of Japan Bulletin n5 p50-9 (1973)  
1973 ; 7refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 458

### **STUDY ON VEHICLE EMISSION BY ENGINE OPERATION UNDER DRIVING SIMULATION. PT. 1. CONTROL AND MEASUREMENT SYSTEM OF SIMULATOR AND ITS CHARACTERISTICS**

An original driving simulator system for experimental study of vehicle emissions is developed. It consists of a main dynamometer control, an engine control, a driving simulation control, and measuring units. Each control system uses a hybrid control method which combines signals of manual

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by K. Yoshiwara; T. Abe  
Publ: SAE of Japan Bulletin n5 p60-70 (1973)  
1973  
Availability: Japan SAE, Tokyo, Japan

HS-014 459

### **ON THE EFFECT OF CRASHWORTHINESS AFFECTING OCCUPANT MOVEMENTS AS EQUIPPED WITH AIR BAG**

With a mathematical model of an occupant equipped with an air bag, the crashworthiness of an experimental safety vehicle (ESV) conforming to crash injury criteria was investigated. The ESV deceleration, deformation, load characteristics, and occupant deceleration were also examined.

by H. Furusho; K. Yokoya  
Publ: SAE of Japan Bulletin n5 p71-80 (1973)  
1973 ; 3refs  
Availability: Japan SAE, Tokyo, Japan

HS-014 460

### **MOTOR CARRIER ACCIDENT INVESTIGATION. OCTAVIO ORTIZ-ALVAREZ AND MANNING MOVING AND STORAGE COMPANY. ACCIDENT--AUGUST 1, 1973, SIKESTON, MISSOURI**

A collision between a straight truck carrying 53 passengers (including 47 illegal entrants) and a tractor-semitrailer carrying printing plates is reported. The straight truck ran off the right side of the roadway and collided with the left rear of the tractor-semitrailer, parked on the shoulder. Ten fatalities, 11 injuries, and \$500 property damage resulted. The driver of the straight truck was undoubtedly fatigued and may have dozed at the wheel. Fatigued drivers, especially during early morning hours, cannot distinguish between moving or stopped vehicles and may be lulled into a hypnotic state, head toward vehicle lights, and collide with a parked vehicle. Thus roadway shoulder parking presents a hazard to other drivers. Photographs are included.

Bureau of Motor Carrier Safety, Washington, D. C.  
Rept. No. 73-7 ; 1974 ; 13p  
Availability: Corporate author

HS-014 461

### **SCHOOL BUS ACCIDENT FACTS 1971-1972. 1972 ED.**

School bus accidents for 1971-72 are summarized, revealing a total of 458 accidents involving 466 buses, one fatality, and 282 injuries. Statistics are presented for several variables: possible contributing circumstances, intended driver action, types of vehicles, directional analysis, county totals, driver age and sex, age of school bus, highway class, types of accidents, horizontal and vertical road character, surface condition, weather conditions, light conditions, monthly totals, and traffic controls. Accident-involved school buses not engaged in transportation of school children were not included in these statistics.

July 31, 1974

HS-800 901

by J. O. Peterson  
Wisconsin Dept. of Transp., Madison  
1972 ; 23p  
Availability: Corporate author

HS-014 462

### **AN OPERATIONAL EVALUATION OF TRUCK SPEEDS ON INTERSTATE HIGHWAYS. FINAL REPORT**

The effectiveness and desirability of a differential truck speed limit on interstate highways is evaluated. Vehicular speed and traffic accident data were collected at 83 sites, embodying a variety of geometric design and operational characteristics, on the Maryland Interstate System. It was shown that there is generally poor adherence by both cars and trucks to posted speed limits. No consistent and reliable relationship could be found among speed parameters, accidents, and accident rates, but a decrease in truck-involved rear-end collisions was noted at locations with higher operating speeds. Excessive speed was cited as a probable cause in 20% of the truck-involved accidents. It is recommended that: on two test sections, the daytime truck speed limit be increased to 70 mph; nighttime truck speed limit be maintained at 60 mph; the sections should be monitored on a continuing basis and evaluated after a two-year study period.

Maryland Univ., College Park. Dept. of Civil Engineering  
1974 ; 122p 122refs  
Prepared in cooperation with Maryland State Hwy.  
Administration and Federal Hwy. Administration.  
Availability: Corporate author

HS-014 463

### **STATISTICAL TECHNIQUES FOR EVALUATING THE EFFECTIVENESS OF STATE MOTOR VEHICLE INSPECTION PROGRAMS IN REDUCING HIGHWAY ACCIDENTS**

Using accident and inspection data from North Carolina and Florida, the effect of periodic motor vehicle inspection on highway crashes is investigated. In both states, accident data from the initial year of the statewide program are examined. It was not possible to restrict the analysis to mechanically-caused accidents, and there were difficulties with the phasing-in schedules and data file linkages. The data do not provide evidence of the effectiveness of periodic motor vehicle inspection in reducing highway accidents, but with the data limitations and the probable small effect of vehicle inspection, it is not unexpected that these studies would fail to detect such an effect.

by D. W. Reinfurt; M. J. Symons  
North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center  
1974 ; 52p 12refs  
Sponsored by the North Carolina Governor's Hwy. Safety Program and the Insurance Inst. for Hwy. Safety.  
Availability: Corporate author

HS-800 899

### **BASIC TRAINING PROGRAM. DRIVER IMPROVEMENT ANALYST. STUDENT STUDY GUIDE**

A student study guide designed to serve as the basic reference source for students and trainees in a driver improvement analyst basic training program is presented. The guide reinforces and supplements the subject material presented in class and contains exhibits referred to during the instruction. Objectives and requirements of the course are outlined, and subsequent chapters deal with: the psychology of driving (driver functions, elements of effective driving); characteristics of the problem (negligent, physically impaired, mentally impaired, alcohol or drug impaired, or aging) driver; vehicle and traffic laws; traffic offenses/violations and traffic accidents; human communication; effective human relations; background for interviewing and counseling; and legal aspects of driver improvement and control actions.

by A. Hale  
Dunlap and Associates, Inc., Darien, Conn.  
Contract DOT-HS-099-2-474  
1973 ; 133p 76refs  
Course Guide is HS-800 900; Instructor's Lesson Plans are HS-800 901. See also HS-800 913.  
Availability: GPO \$2.10 as Stock 0b5003-00-138 no.5003-00-138

HS-800 900

### **BASIC TRAINING PROGRAM. DRIVER IMPROVEMENT ANALYST. COURSE GUIDE**

A course guide for aiding the training administrator/course coordinator in his planning and conduct of the basic training program for driver improvement analyst is presented. It contains a description of the overall training program and instructor and student materials; suggestions for course planning including the scheduling of lessons, class size, prerequisites for students and instructors, training facilities and resources; guidelines for conducting the course; and recommendations for measuring student achievement.

by A. Hale  
Dunlap and Associates, Inc., Darien, Conn.  
Contract DOT-HS-099-2-474  
1973 ; 45p 76refs  
Student Study Guide is HS-800 899; Instructor's Lesson Plans are HS-800 901. See also HS-800 913.  
Availability: GPO \$0.55 as Stock no.5003-00-137

HS-800 901

### **BASIC TRAINING PROGRAM. DRIVER IMPROVEMENT ANALYST. INSTRUCTOR'S LESSON PLANS**

mation, vehicle and traffic laws, traffic offenses/violations and traffic accidents, human communication, effective human relations, theory and practice of interviewing and counseling, driver improvement procedures, and practical applications.

by A. Hale  
Dunlap and Associates, Inc., Darien, Conn.  
Contract DOT-HS-099-2-474  
1973 ; 323p 76refs  
Student Study Guide is HS-800 899; Course Guide is HS-800 900. See also HS-800 913. 913.  
Availability: GPO \$3.50 as Stock no. 5003-00-136

HS-801 101

## **VEHICLE DISABLEMENT STUDY. EXECUTIVE**

cases of on-road failure in the form of cross-tabulation of component faults by year, make, and model of vehicle. Vehicle make and model year for sample vehicles were correlated with comparable data at the county, state, and national levels. Values ranged from 08 for county and sample to 08 for national and sample comparisons. The high correlation indicated that the sample was representative of the vehicle population and validated the identification of critical component systems for disablements.

by D. N. Schmidt; W. L. Raley; W. R. Long; L. C. Holter  
Traffic Safety Res. Corp., Palo Alto, Calif.  
Contract DOT-HS-261-3-771  
Rept. No. TSR2102 ; 1974 ; 36p  
Rept. for Jul 1973-Jan 1974.  
Availability: NTIS

## **SUBJECT INDEX**

ABDOMINAL IMPACT TOLERANCES  
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EXPERIMENTAL INSTALLATIONS OF IMPACT-ATTENUATING DEVICES.

## **CONTRACTS AWARDED**

## NHTSA CONTRACTS AWARDED

### **DOT-HS-031-3-722 Mod. 3**

#### **ASAP BASELINE VOLUNTARY SURVEY**

The Regents of the University of Michigan  
260 Research Administration Building  
Ann Arbor, Mich. 48105

Extended through 30 Sept 74

Increased \$50,840.00

Available data from the 28 OAC sponsored Alcohol Safety Action Programs will be collected on magnetic tape to be housed in the archives at HSRI. This data is to be reorganized into a single comprehensive computer format of variables and code categories from which comparisons will be made as to geographic area, time element, age, sex, education, occupation, marital status and number of passengers. Comparable data is to be obtained when available from summary reports of surveys not in the archive. A final report comparing the ASAP roadside survey results with the National Roadside Survey results is to be prepared by 30 September 1974.

### **DOT-HS-036-3-712 Mod. 1**

#### **MODEL POLICE TRAFFIC SERVICES POLICY DOCUMENT AND MODEL PROCEDURES MANUAL FOR POLICE SERVICES**

International Association of Chiefs of Police, Inc.  
Eleven Firstfield Road  
Gaithersburg, Md. 20760

Extended to 30 June 1975

Increased by \$54,774.00

Year Two of this three year contract is to produce a *Model Police Traffic Services Procedure Document* establishing the means whereby the model policies and their intent may be effectuated. A procedure is defined as "a method of performing an operation or a manner of proceeding on a course of action". Policy establishes the limits of action while procedure directs response within those limits. Model policies as set out in the Phase One document will be implemented and the procedures document will cover the same subject areas which include in part: traffic law enforcement; accident investigation, reporting and management; motorist services; staff administrative services; and control and direction of traffic. Further, an initiation of the effort designed to produce *model rules and regulations* in Year Three will be accomplished.

### **DOT-HS-065-3-724 Mod. 1**

#### **DETERMINATION OF MOTOR VEHICLE CHARACTERISTICS AFFECTING DRIVER HANDLING PERFORMANCE**

Texas A&M Research Foundation  
F. E. Box H  
College Station, Tex. 77843

29 June 73 to 28 June 74

Increased \$60,838.00

A test plan for the continuation of the vehicle-driver handling tests will be developed to include planned test dates, periods of usage of test vehicles, maneuvers to be conducted by each driver and selection schedule for additional drivers. The Contractor will select and familiarize an adequate number of additional drivers in order to allow for a more statistically significant data base and to permit exploration of the extremities of the vehicle-driver population.

### **DOT-HS-099-3-728 Mod. 1**

#### **DEVELOPMENT OF MODEL REGULATIONS FOR PEDESTRIAN SAFETY**

Dunlap and Associates, Inc.  
One Parkland Drive  
Darien (Fairfield), Conn. 06820

Extended to 31 July 74

\$5,775.00

An additional countermeasure regulation dealing with vehicle backup warning devices shall be accomplished. The Contractor will develop a data collection instrument; collect public and official data via survey; analyze the data collected; prepare a model regulation and supporting documentation; and include discussion of the countermeasure and resulting regulation in the final report.

### **DOT-HS-153-2-239 Mod. 13**

#### **ALCOHOL SAFETY ACTION PROGRAM**

State of Idaho  
Traffic Safety Commission  
2419 West State Street  
Boise, Idaho 83702

Extended to 31 Dec 75

Increased \$69,316.00

Statement of Work is changed effective 1 February 1974 to incorporate by reference Revision No. 7 which provides for the conducting of Judicial and Pre-Sentence Investigators Seminars, and a final report.



**DOT-HS-160-2-251 Mod. 8**

**ALCOHOL SAFETY ACTION PROJECT**

Puerto Rico Highway Safety Comm.  
P.O. Box 8036  
San Juan, Puerto Rico 00910

Extended through 31 Dec 75

\$867,964.00

A detailed plan, entitled "Puerto Rico Alcohol Safety Action Project", dated 15 February 1974, is hereby incorporated into the contract. This document constitutes a complete revision of the Puerto Rico ASAP.

**DOT-HS-163-2-256 Mod. 11**

**ALCOHOL SAFETY ACTION PROJECT**

City of Sioux City  
P.O. Box 447  
Sioux City, Ia. 51102

No change

\$146,283.00

The Contractor shall furnish the necessary facilities, materials, personnel and such other services as may be required, in consultation with the Government, to implement and evaluate a comprehensive countermeasures program designed to reduce the role of alcohol as a contributing factor in highway crashes. The Contractor's plan as revised in 1972 is incorporated by reference.

**DOT-HS-190-2-480 Mod. 5**

**PEDESTRIAN ACCIDENT COUNTERMEASURES EXPERIMENTAL EVALUATION**

Bio Technology, Inc.  
3027 Rosemary Lane  
Falls Church, Va. 22042

Extended to 26 Feb 75

Increased \$48,066.00

The Pedestrian Accident Report Collection will be continued to provide continuity of the existing data base. The Contractor will visit each of the 6 cities involved and make all efforts necessary to secure the cooperation of the Police Departments to continue providing the necessary supplemental data. The current data form will be modified to eliminate ambiguities and to ensure that the new format is compatible with 1973 data. If required by the city, a reasonable fee will be paid for copies of the regular accident

report or police man hours necessary to complete the supplementary form. All data will be coded and converted to magnetic tape for detailed analysis. The current Accident Typology Sorting Logic will be converted to a fully operational sorting program for computer usage. Cities will be provided with a six-month and a one-year statistical summary of its accident data.

**DOT-HS-230-3-674 Mod. 1**

**SOURCES AND REMEDIES FOR RESTRAINTS SYSTEM DISCOMFORT AND INCONVENIENCES**

Man-Factors, Inc.  
4433 Convoy Street  
San Diego, Calif. 92111

Extended through 31 July 1974

Increased \$15,309.00

The Contractor shall compare the Man-Factor's proposed optimal safety belt configuration with both proposed passive belt systems and other 1974 belt systems for an evaluation of optimized restraint systems.

**DOT-HS-249-3-704 Mod. 1**

**SYMPOSIUM ON HIGHWAY SAFETY AND TRAFFIC OFFENSE ADJUDICATION**

University of Denver  
College of Law  
200 West 14th Avenue  
Denver, Colorado 80204

No change

\$13,574.00

This modification provides for the preparation and conduct of a pre-symposium briefing meeting in Belmont and the development of discussion group material for the symposium in New York.

**DOT-HS-256-3-688 Mod. 3**

**BINOCULAR AND MONOCULAR FIELD OF VIEW PERFORMANCE TEST**

Tracor/Jitco, Inc.  
1300 E. Gude Drive  
Rockville, Md. 20851

Extended to 29 May 74

Increased \$8,492.00

This modification requires the measurement on three passenger cars and one truck of obstruction in the

forward and rearward fields of view using the testing procedure, or equivalent, stipulated in the General Testing Laboratory report "Vehicle Obstructions in Direct Field of View". Using the eye reference points, or equivalent, specified in Digitek's "Evaluation of Direct Visibility for Automotive Passenger Vehicle by a Figure of Merit" the obstructions and up angle are to be measured on the same four vehicles. Data acquired, together with data from the GLT and Digitek reports, are to be mathematically converted to equivalent data taken for the vehicles previously compared under this contract.

**DOT-HS-258-2-462 Mod. 4**

**MULTIDISCIPLINARY ACCIDENT INVESTIGATION**

University of New Mexico  
College of Engineering  
Albuquerque, N. M. 87106

No change

Increased \$13, 600.00

On-site, in-depth investigation utilizing the multidisciplinary approach shall be made of 15 accidents. In addition, the Contractor will investigate all crashes involving passive restraint and/or crash recorder equipped vehicles forming a part of the NHTSA fleet located in his general area and any similarly equipped vehicle crashes as may be designated by the Contract Technical Manager. The Contractor shall further be prepared to investigate all school bus accidents occurring in his area which involve three or more fatally injured passengers, or which may be designated by the CTM.

**DOT-HS-322-3-621 Mod. 2**

**TEST AND ENGINEERING SUPPORT FOR THE ESV PROGRAM**

Battelle Memorial Institute  
505 King Avenue  
Columbus, Ohio 43201

No change

Increased \$93,980.00

The Contractor will assess the degree of crash survivability provided by a sedan, station wagon, and a van during three specific crash environments. The assessment will be made on occupant injury and structural intrusion criteria as selected by the Government. A frontal barrier impact, a moving barrier

degree to which crash survivability could be enhanced if selected design improvements were incorporated will be assessed. Determination of the weight penalty, the cost, and the benefits of the selected design improvements in terms of percent reduction in fatalities are to be estimated.

**DOT-HS-363-3-756 Mod. 2**

**TRAFFIC/RECORDS SYSTEMS TRANSFERABILITY MODEL MASTER PLAN DEVELOPMENT PROJECT**

Idaho Traffic Safety Commission  
2419 West State Street  
Boise, Idaho 83702

Extended to 30 June 75

Increased by \$50,000.00

The objective of the Idaho Traffic Records System Model Master Plan extension is to demonstrate the capability to implement in other States the Traffic Records Systems computer software and related procedures used in one State. An operational Traffic Records Systems Data Base design from the selected transfer site will be used. Actual operations for the accident component software will begin during the implementation contract phase. Component software for remaining Traffic Records Subsystems will have been transferred to Idaho but may not be operational during this contract period. An IMS Computer Operator's Guide, Report 7, to assist personnel in implementing the IMS system for test and operational purposes shall be submitted as well as a preliminary Idaho Traffic Records System Data Base Description Manual. The State will begin collection of data utilizing a revised accident data report form on 1 January 1975 and the accident data base component shall be operational and capable of producing data reports on calendar year 1975.

**DOT-HS-4-00866**

**VEHICLE ROLLOVER TESTING**

Department of Transportation  
Federal Aviation Agency  
Atlantic City, N.J. 08405

FY 74

\$19,054.64

The scope of the program is to perform rollover tests on three baseline vehicles in order to obtain data to be used in a subsequent research and development

male test devices will be tested at a velocity of  $30+0.5$  mph. The test devices will be positioned on the downside of the vehicle, one in the front and the other in the rear seat. These devices will be instrumented to measure orthogonal accelerations of the head and chest. High-speed photographic coverage will record the test and a sensing device will record time of vehicle departure from the test device.

#### **DOT-HS-4-00869 Mod. 2**

##### **LABOR HOUR CONTRACT FOR CODING, EDITING AND KEYPUNCH**

Opportunity Systems, Inc.  
1330 Massachusetts Avenue, N.W.  
Washington, D.C. 20005

No change

Increased \$6,427.20

The Coder/Editor's time is increased and a second Coder/Editor shall begin work 17 June 74 and continue until 27 September 74.

#### **DOT-HS-4-00881**

##### **THE IMPACT OF YEAR-ROUND DAYLIGHT SAVING TIME UPON TRAFFIC DEATHS AND INJURIES**

The Center for the Environment of Man, Inc.  
275 Windsor Street  
Hartford, Conn. 06120

To be completed 1 May 74

\$9,149.00

In an attempt to evaluate the impact of year-round daylight saving time upon traffic deaths and injuries, an analysis will be made, based upon tables of such deaths and injuries by the hour of the day and the week of the year. Because of the variation within the United States in geographical latitude and longitude, the intensity of daylight at a certain hour on a certain day is reached in other places on the same day at a different hour or at the same hour on a different day. For this reason, analysis of the portion of the sun in the areas studied, Texas, Virginia, and Washington, and the number of accidents on record will determine whether time periods of one week, two weeks, months or other periods are appropriate for study. Using accident data tapes covering a two year period, tabulation of the number of traffic fatalities and injuries will be made. For pedestrian and bicyclists of ages 5-17 killed or injured during the hours 7-9 a.m., support tabulations will be made. By studying changes during periods of daylight saving time and normal

zone time, accident variations in morning and the evening hours, and a representative number of deaths and injuries, the differences in injuries and fatalities will be calculated and expressed as percentages of the total of such for the areas studied. A discussion of how these figures may be used as a projection for the entire U.S. will follow.

#### **DOT-HS-4-00882**

##### **NON-LINEAR MULTIVARIATE MODELING OF HEAD INJURY**

Adaptronics, Inc.  
Westgate Research Park  
7700 Old Springhouse Road  
McLean, Va. 22101

17 Apr 74 to 17 Apr 75

\$67,451.00

Utilizing data previously collected through monitoring a sufficient and uniform set of kinematic, kinetic, and physiological parameters gained during experimental head impact and inertial loading of the head studies, an effort will be made to analyze and evaluate the efficacy of the adaptive modeling and systems control techniques embodied in the proprietary computer software programs (CLUSTER, PNETTR, and GARS) of Adaptronics, Inc. Indicators of body processes such as respiration with life variables, will help the contractor formulate an adaptive non-linear model. This model will assess the sensitivity the maintenance of life has to these various parameters and evaluate the capability of the PNETTR-GARS control technique for determining a clinical on-line strategy for the maintenance of life of a head injury patient.

#### **DOT-HS-4-00884**

##### **DEVELOPMENT OF A LABORATORY PROCEDURE FOR FMVSS No. 125, WARNING DEVICES**

Southwest Research Institute  
8500 Culebra Road  
San Antonio, Texas 78284

7 June 74 to 29 July 74

\$3,505.00

A detailed laboratory procedure will be developed, and verified by testing. A text will be prepared by the Contractor as a guide to the procedure. This text will set out, in part, guidelines for the purpose and scope, test procedure and test quantities, test conditions and schedule, calibration of measurement and test equipment, as well as requirements and reports of the entire laboratory procedure.

**DOT-HS-4-00885**

**DRIVER IMPROVEMENT TRAINING**

U.S. Coast Guard  
400 West Seventh Street, S.W.  
Washington, D.C. 20590

To be completed no later than four (4) months after contract award

\$9,500.00

Assisted by a Contractor, the Coast Guard will collect and compare the updated accident records of trained and untrained groups of USCG recruits in an effort to determine the effectiveness of the National Highway Traffic Safety Administration/U.S. Coast Guard Driver Improvement Training Program in reducing accidents, injuries, and fatalities.

**DOT-HS-4-00887**

**PREDICTING SOCIETAL BENEFITS AND COSTS RESULTING FROM THE IMPLEMENTATION OF TITLE II, PL 92-513-STUDY DESIGN, PHASE II**

Center for the Environment and Man, Inc.  
275 Windsor Street  
Hartford, Conn. 06120

To be completed no later than nine (9) months after contract award

\$99,872.00

Objectives are to predict significant economic, sociological, environmental, political, safety and other consequences resulting from alternative ways of implementing Title II of the "Motor Vehicle Information and Cost Saving Act"; to identify significant trade-offs among the various alternatives; and to predict net societal benefits or losses resulting from implementation of selected alternative methods. The Contractor will achieve these objectives through estimates of consumer automobile purchase patterns; development of models which will allow estimation of how change in the mix of new cars sold will affect injuries, fatalities and property damage in crashes; development of models to estimate societal effects from changes in car sales, automobile repair cost, crash damage and injuries; and by development of alternative ways of presenting Title II information for all of these.

**DOT-HS-4-00888**

**PREDICTING SOCIETAL BENEFITS AND COSTS RESULTING FROM THE IMPLEMENTATION OF TITLE II, PL 92-513-STUDY DESIGN, PHASE II**

Arthur D. Little  
Acorn Park  
Cambridge, Mass. 02140

To be completed no later than eight (8) months after contract award

\$95,710.00

This study is to concentrate on using informed judgment to provide insights and estimates on how the Motor Vehicle Information and Cost Savings Act (MVICSA) will affect new automobile purchasers and automobile manufacturers. It will attempt to answer two basic questions: will implementing MVICSA change the buying behavior of consumers, and will implementing the MVICSA cause automobile manufacturers to pay more attention to operating costs and safety considerations in the design of their products? The Contractor will restrict himself to issues dealing only with new car sales and make estimates as to changes in car buying behavior, consumer payments for new automobiles, effects on the insurance and automobile parts industries, socio-political effects and reduction in automobile accident costs.

**DOT-HS-4-00889**

**DATA ACQUISITION SYSTEM (DAS)**

Data Systems, Inc.  
420 Jefferson Building  
1600 West 38th Street  
Austin, Tex. 78731

To be completed no later than seven (7) months after contract award

\$35,000.00

The Mobile Tire Traction Dynamometer (MTTD) will collect tire force data and provide the National Highway Traffic Safety Administration with an accurate and precise method of research into fundamental tire mechanics, a knowledge of which is needed to find ways of rating tires in braking and cornering for a minimum traction standard and quality grading system. Analog data will include truck forward velocity, test wheel forward velocity, percent slip desired, steering angle, load on test tire, longitudinal force, lateral force and actual percent slip.

## **MANAGEMENT BY OBJECTIVES**

Organizational Development Associates, Inc.

Suite 549

1500 Massachusetts Ave., N.W.

Washington, D.C. 20005

To be completed by 30 Jan 75

\$7,500.00

Three workshops in Management by Objectives will be developed to meet specific needs of Traffic Safety Programs (TSP). These will be two-day sessions and will include MBO theory and practice, practical exercises, and problems based work requirements in TSP. Methods will include group discussions, questions and answers, recommendations and critiques.

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Office of Administration

WASHINGTON, D.C. 20590

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